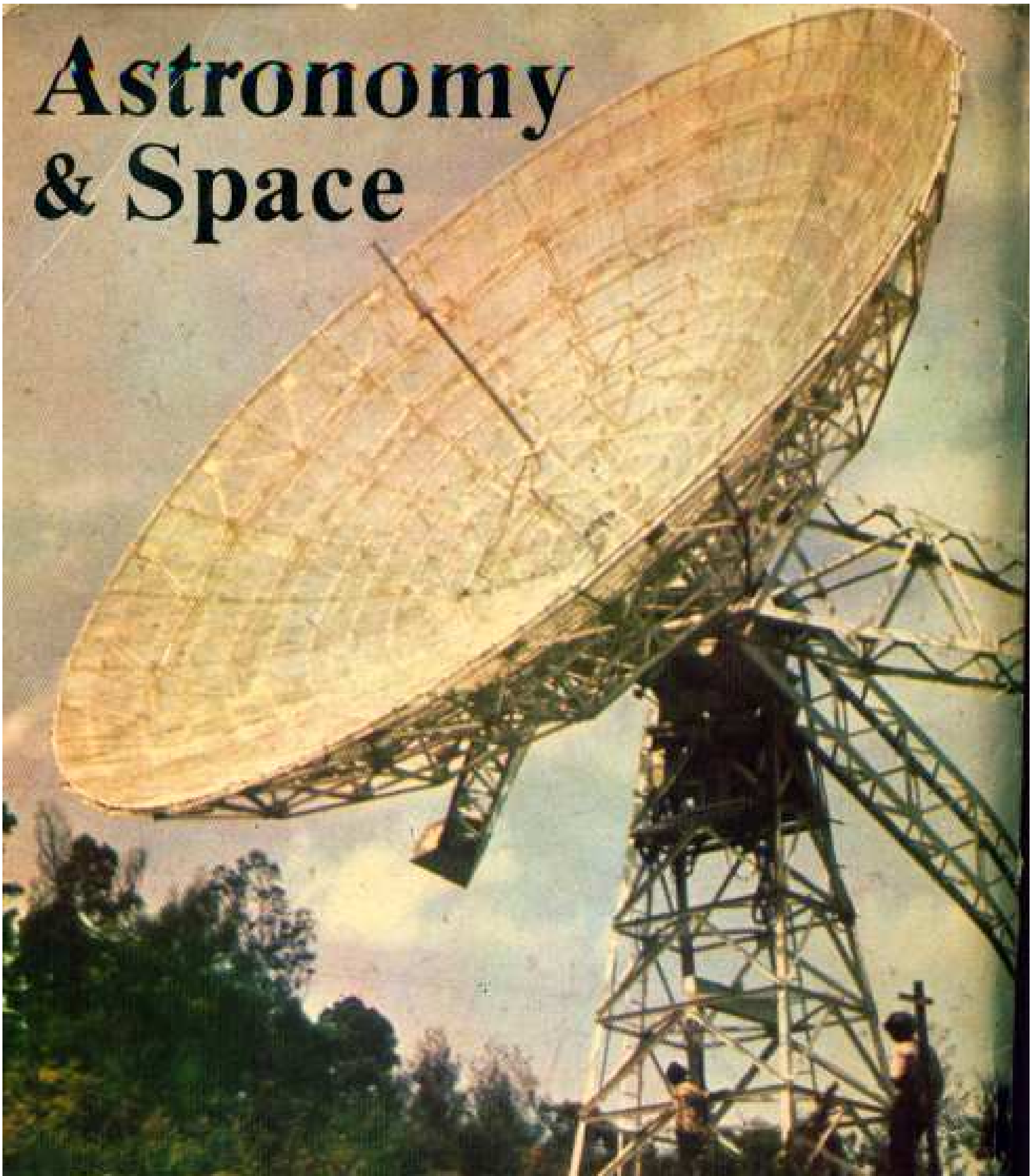
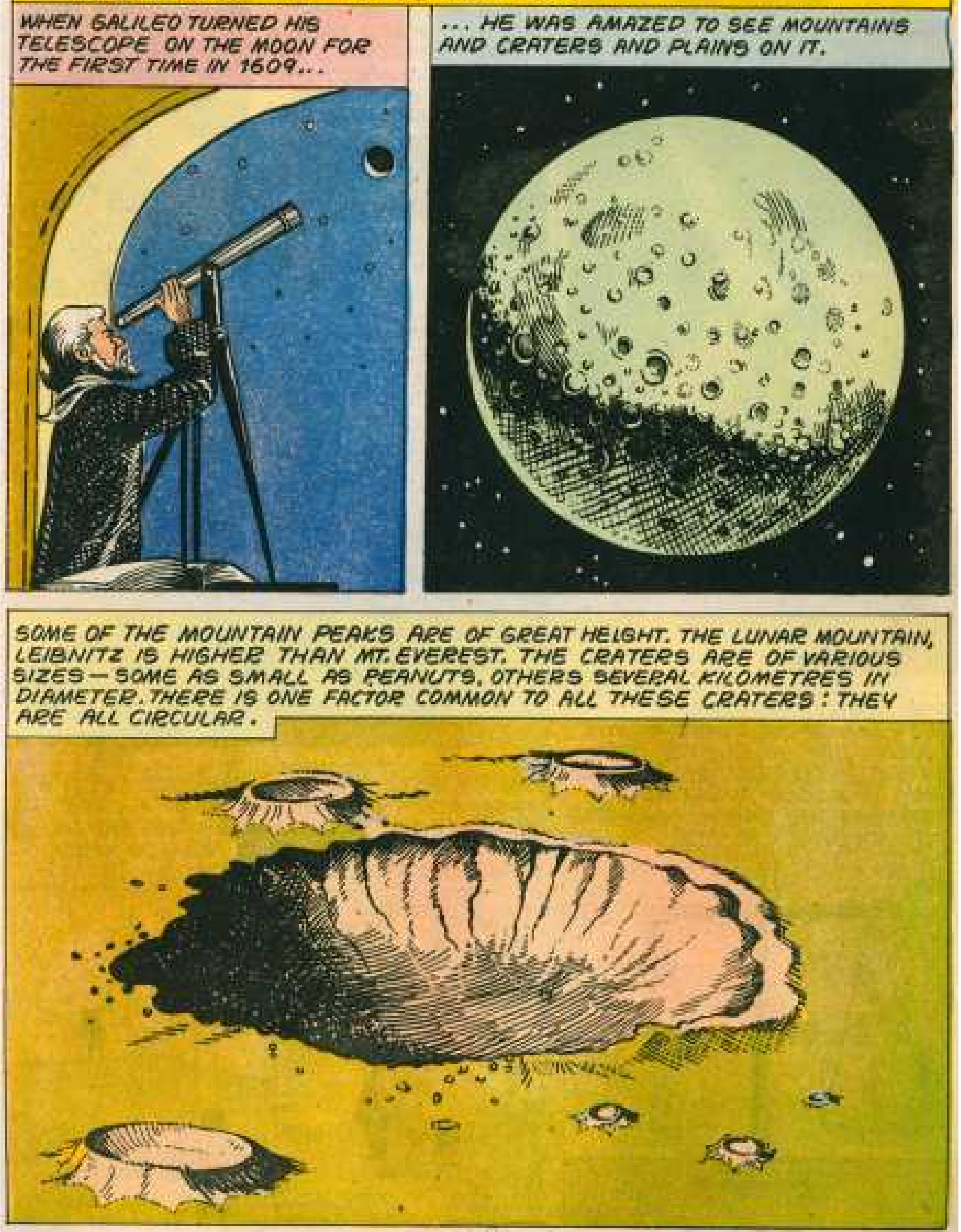
Astronomy & Space

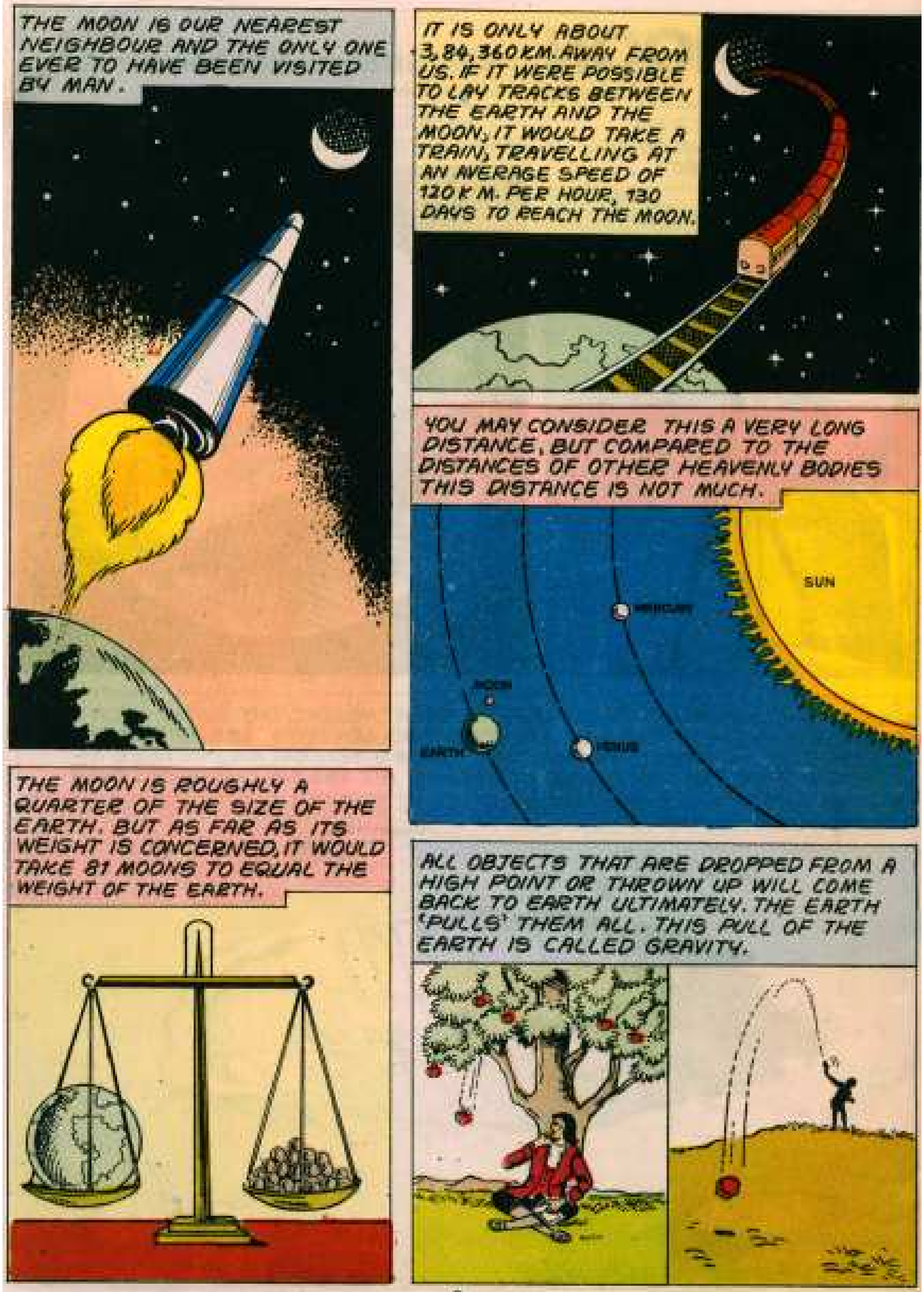


FROM THE HOUSE OF AMAR CHITRA KATHA

THE MOON —Our Strange Neighbour —1

Script : J.D. Isloor • Illustrations : Anand Mande





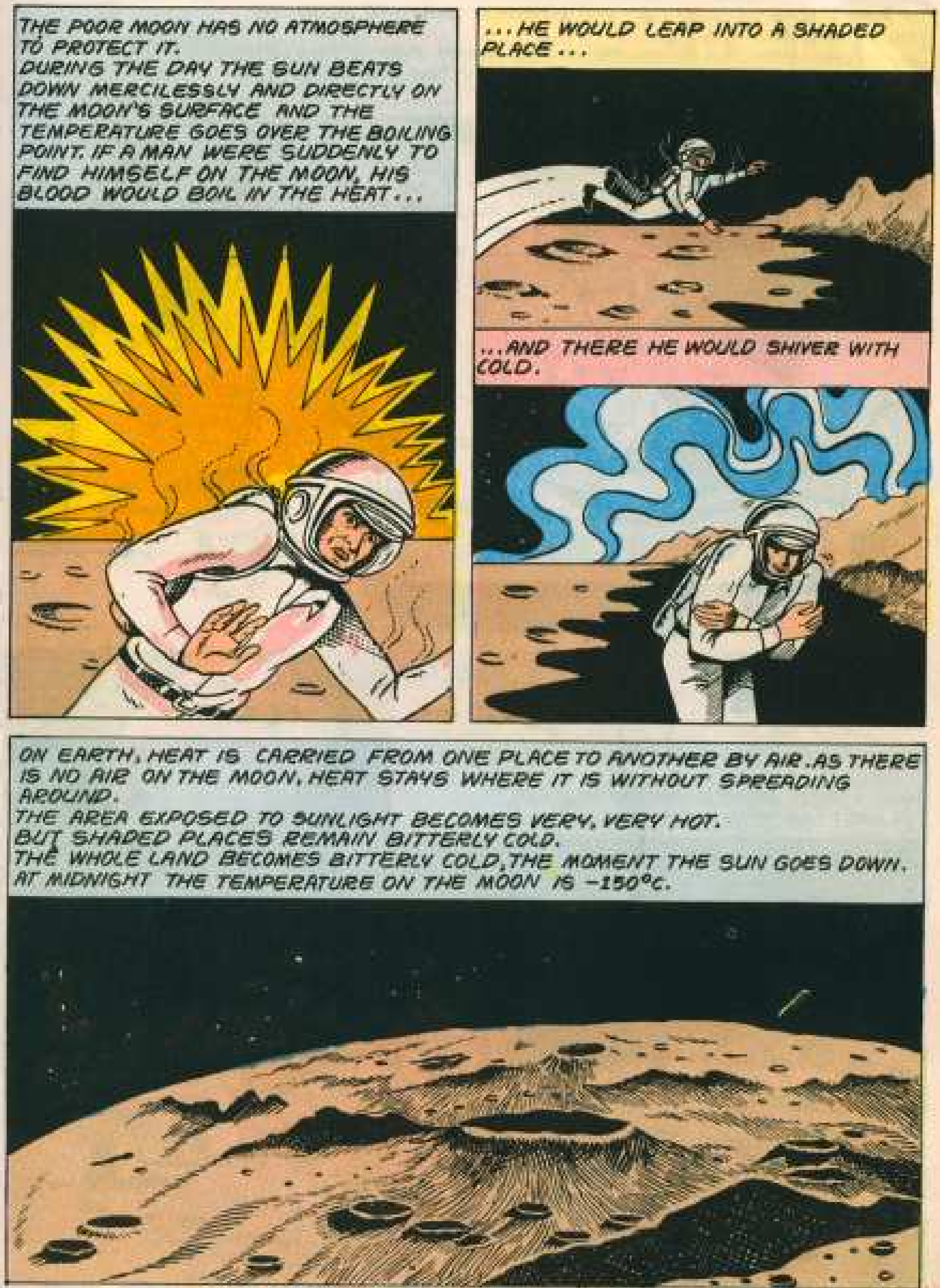
THE MOON IS OUR NEAREST NEIGHBOUR AND THE ONLY ONE EVER TO HAVE BEEN VISITED BY MAN.
IT IS ONLY ABOUT 3,84,360 KM. AWAY FROM US. IF IT WERE POSSIBLE TO LAY TRACKS BETWEEN THE EARTH AND THE MOON, IT WOULD TAKE A TRAIN, TRAVELLING AT AN AVERAGE SPEED OF 120 KM. PER HOUR, 130 DAYS TO REACH THE MOON.
THE MOON IS ROUGHLY A QUARTER OF THE SIZE OF THE EARTH. BUT AS FAR AS ITS WEIGHT IS CONCERNED, IT WOULD TAKE 81 MOONS TO EQUAL THE WEIGHT OF THE EARTH.
YOU MAY CONSIDER THIS A VERY LONG DISTANCE, BUT COMPARED TO THE DISTANCES OF OTHER HEAVENLY BODIES THIS DISTANCE IS NOT MUCH.
SUN
ALL OBJECTS THAT ARE DROPPED FROM A HIGH POINT OR THROWN UP WILL COME BACK TO EARTH ULTIMATELY. THE EARTH 'PULLS' THEM ALL. THIS PULL OF THE EARTH IS CALLED GRAVITY.

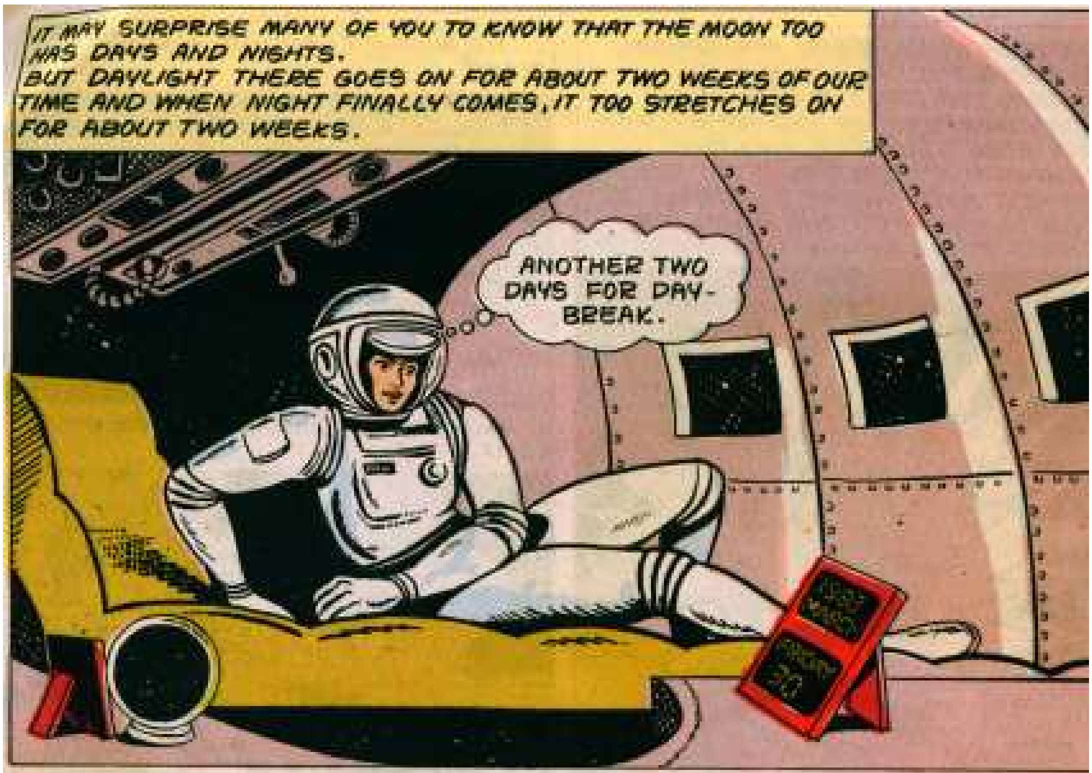

THE WEIGHT OF EVERYTHING DEPENDS ON GRAVITY. THIS MAN CANNOT LIFT THIS BAR-BELL WEIGHING 180 KGS.
BUT HE WOULD BE ABLE TO LIFT IT EASILY ON THE MOON BECAUSE THERE IT WOULD WEIGH ONLY 30 KGS. THE MOON'S GRAVITY OR PULLING POWER IS ONLY 1/6 TH THAT OF THE EARTH.
YOU CAN'T JUMP TOO HIGH ON THE EARTH, BECAUSE THE EARTH PULLS YOU DOWN VERY STRONGLY. IF YOU CAN JUMP 4 FEET HIGH HERE...
...ON THE MOON, YOU WOULD BE ABLE TO JUMP 24 FEET (6X4) BECAUSE EVEN THOUGH YOU WOULD BE SIX TIMES LIGHTER THERE, YOUR ENERGY WOULD REMAIN THE SAME.
IT IS DIFFICULT TO FALL ON THE MOON. THE ASTRONAUTS FOUND THAT IF THEY LOST THEIR BALANCE THEY BEGAN TO FALL IN SLOW MOTION, GIVING THEM PLENTY OF TIME TO REGAIN THEIR BALANCE.

THE MOON —Our Strange Neighbour —2

Script : J.D. Isloor • Illustrations : Anand Mande




THE POOR MOON HAS NO ATMOSPHERE TO PROTECT IT. DURING THE DAY THE SUN BEATS DOWN MERCILESSLY AND DIRECTLY ON THE MOON'S SURFACE AND THE TEMPERATURE GOES OVER THE BOILING POINT. IF A MAN WERE SUDDENLY TO FIND HIMSELF ON THE MOON, HIS BLOOD WOULD BOIL IN THE HEAT...
...HE WOULD LEAP INTO A SHADED PLACE...
...AND THERE HE WOULD SHIVER WITH COLD.
ON EARTH, HEAT IS CARRIED FROM ONE PLACE TO ANOTHER BY AIR. AS THERE IS NO AIR ON THE MOON, HEAT STAYS WHERE IT IS WITHOUT SPREADING AROUND. THE AREA EXPOSED TO SUNLIGHT BECOMES VERY, VERY HOT. BUT SHADED PLACES REMAIN BITTERLY COLD. THE WHOLE LAND BECOMES BITTERLY COLD, THE MOMENT THE SUN GOES DOWN. AT MIDNIGHT THE TEMPERATURE ON THE MOON IS -150°C.

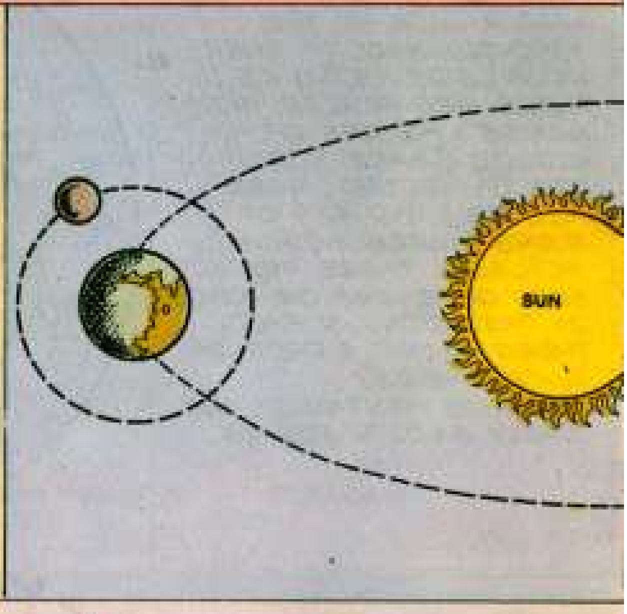

IT MAY SURPRISE MANY OF YOU TO KNOW THAT THE MOON TOO HAS DAYS AND NIGHTS.
BUT DAYLIGHT THERE GOES ON FOR ABOUT TWO WEEKS OF OUR TIME AND WHEN NIGHT FINALLY COMES, IT TOO STRETCHES ON FOR ABOUT TWO WEEKS.
ANOTHER TWO DAYS FOR DAY-BREAK.


WE GET MOONLIGHT AT NIGHT. WHAT DOES THE MOON GET? EARTHLIGHT.
EARTH, LIKE THE MOON, DOES NOT HAVE ANY LIGHT OF ITS OWN, BUT IT REFLECTS SUNLIGHT. AND IT REFLECTS IT BETTER THAN THE MOON DOES.
YOU COULD READ A PAPER VERY COMFORTABLY IN EARTHLIGHT.

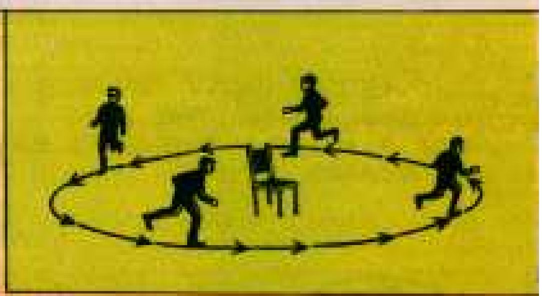
THE MOON — Our strange neighbour — 3

Script : J.D. Isloor • Illustrations : Anand Mande

THE MOON GOES ROUND THE EARTH. IT MOVES VERY FAST, COVERING ABOUT 60,000 KM. PER DAY.
YET IT TAKES 27 1/3 DAYS TO CIRCLE THE EARTH ONCE.
AS IT GOES ROUND THE EARTH, IT ALSO SPINS LIKE A TOP.
A TOP SPINS VERY FAST. IT TAKES NO TIME AT ALL TO MAKE ONE TURN. BUT THE MOON SPINS VERY SLOWLY IN COMPARISON. IT TAKES 27 1/3 DAYS TO MAKE ONE TURN.
YOU WILL NOTICE THAT IT TAKES THE SAME NUMBER OF DAYS TO TURN ONCE ROUND ITSELF AND TO MAKE ONE ORBIT ROUND THE EARTH.



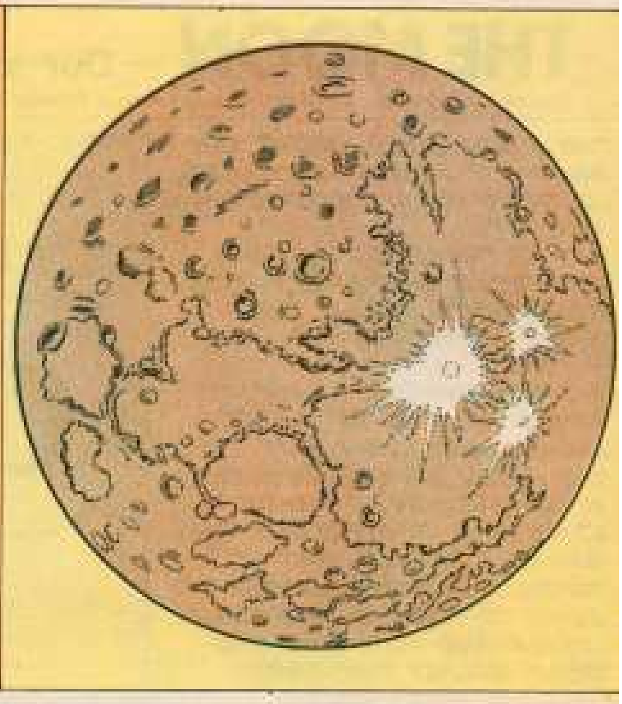
IF YOU KEEP A CHAIR IN THE CENTRE OF A ROOM AND GO ROUND IT IN AN ANTI-CLOCKWISE DIRECTION, IT IS YOUR LEFT SIDE WHICH WILL BE TURNED TOWARDS IT ALL THE TIME.



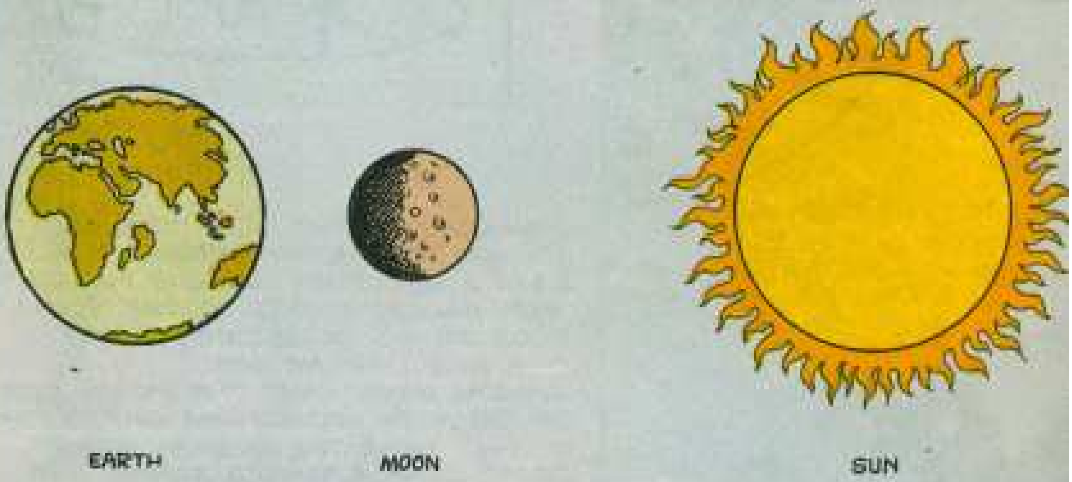


SIMILARLY, AS THE MOON TRAVELS ROUND THE EARTH, IT KEEPS THE SAME SIDE TURNED TOWARDS THE EARTH. WHEN GALILEO LOOKED AT THE MOON THROUGH HIS TELESCOPE, IT WAS THIS SIDE THAT HE SAW.
NOBODY KNEW WHAT THE HIDDEN SIDE OF THE MOON LOOKED LIKE UNTIL 1959. IN THAT YEAR THE RUSSIAN SPACE-CRAFT, LUNA 3, PASSED BEHIND THE MOON, TOOK PICTURES AND SENT THEM BACK TO EARTH.
IT WAS FOUND THAT THE HIDDEN SIDE LOOKED VERY MUCH LIKE THE SIDE TURNED TOWARDS US.

HAVE A LOOK AT THE FRIENDLY FACE OF THE MOON (SIDE FACING US). THERE ARE PLACES WITH NAMES LIKE SEA OF CLOUDS (MARE NUBIUM), SEA OF NECTAR (MARE NECTAR) AND SEA OF RAINS (MARE INTRIUM). ACTUALLY THERE ARE NO SEAS OR RIVERS OR PONDS ON THE MOON. IN FACT, THERE IS NOT A DROP OF WATER THERE.
THE SEAS MENTIONED ARE FAIRLY SMOOTH PLAINS.

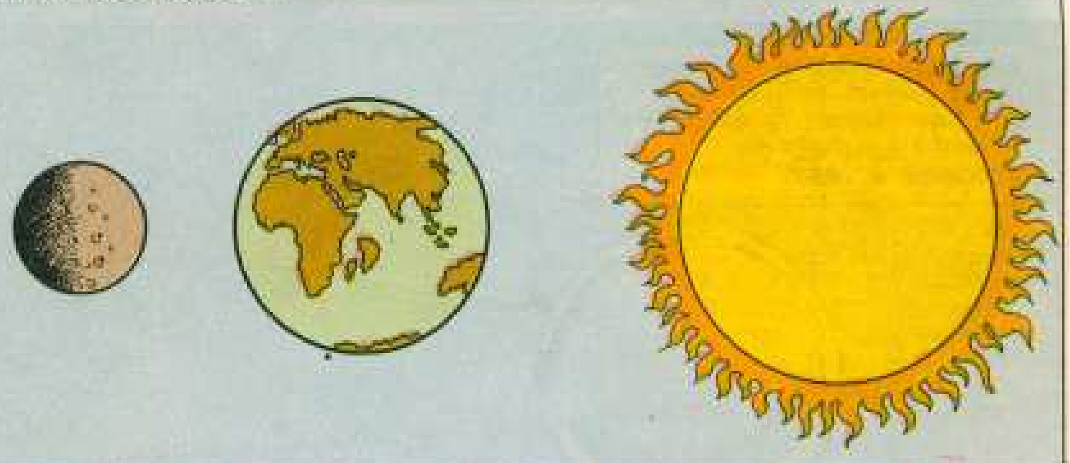


JUST AS THE MOON TRAVELS ROUND THE EARTH, THE EARTH TRAVELS ROUND THE SUN.
ONCE A MONTH, THE SUN, EARTH AND MOON ARE IN THIS POSITION–



THE SIDE OF THE MOON TURNED TOWARDS THE EARTH IS NOT LIGHTED UP BY THE SUN AND SO WE CAN'T SEE THE MOON AT ALL. WE SAY IT IS A NEW MOON.

TWO WEEKS LATER, THE SUN, THE EARTH AND THE MOON ARE IN THIS POSITION —



THEN THE SUN CAN SHINE ON THE SIDE OF THE MOON WHICH IS TOWARDS US AND WE SEE A FULL MOON.

ANOTHER TWO WEEKS AND THE THREE BODIES ARE BACK IN THE FIRST POSITION. IN BETWEEN, SOME BUT NOT ALL OF THE MOON'S LIGHTED SIDE IS TURNED TOWARDS US AND WE SEE THE MOON BECOMING EITHER FULLER AND FULLER OR THINNER AND THINNER.

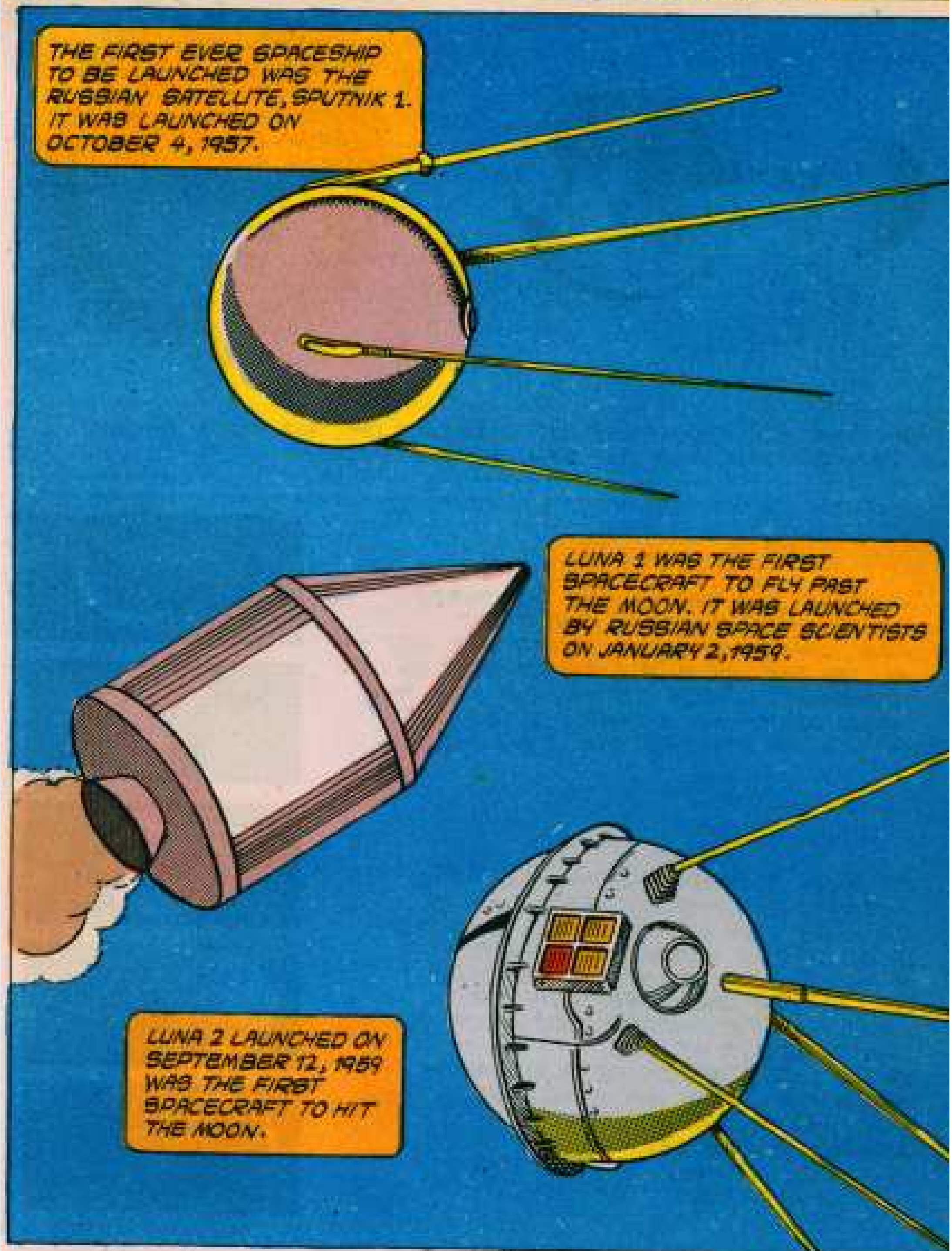
SO EVEN THOUGH ONE HALF OF THE MOON IS ALWAYS LIGHTED BY THE SUN, WE CAN SEE THE FULL LIGHTED SIDE OF THE MOON ONLY ONCE A MONTH. THE REST OF THE TIME WE CAN SEE ONLY PARTS OF THE LIGHTED SIDE AND AT NEW MOON WE CAN'T SEE IT AT ALL.
IF WE WERE WATCHING OUR EARTH FROM THE MOON WE WOULD SEE OUR EARTH TOO IN VARIOUS SHAPES AND SIZES.

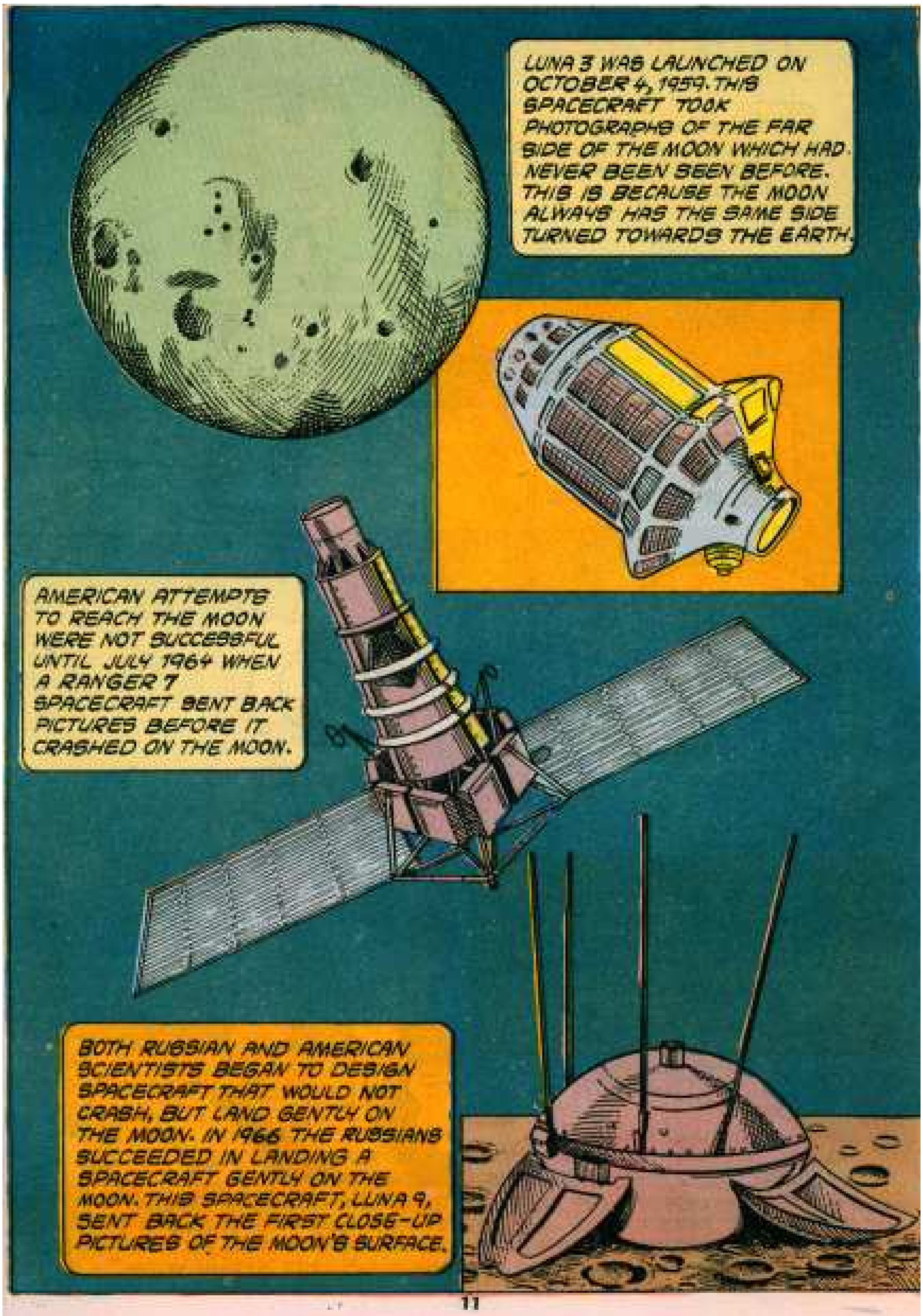


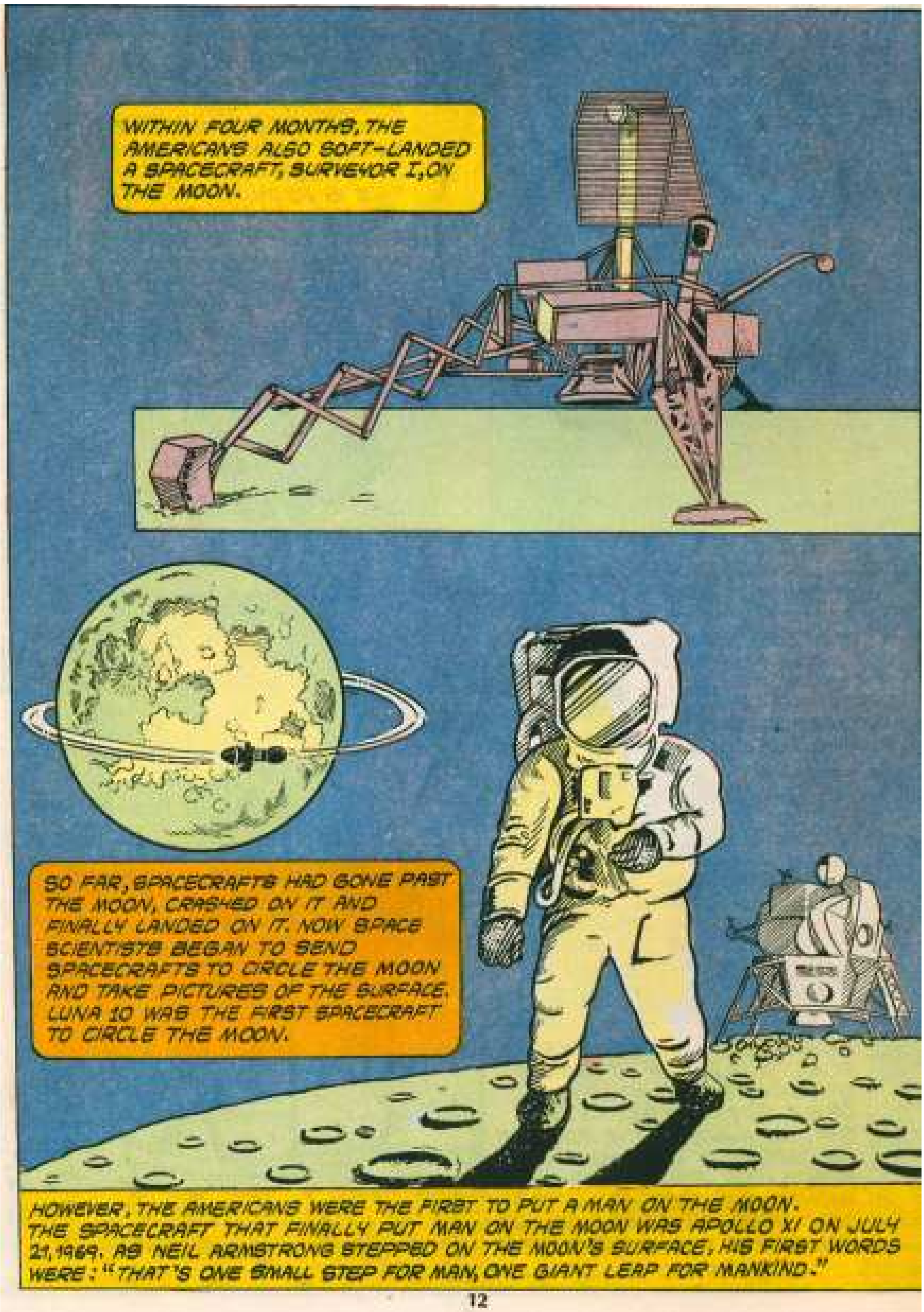
PHASES OF THE MOON

The race to the moon

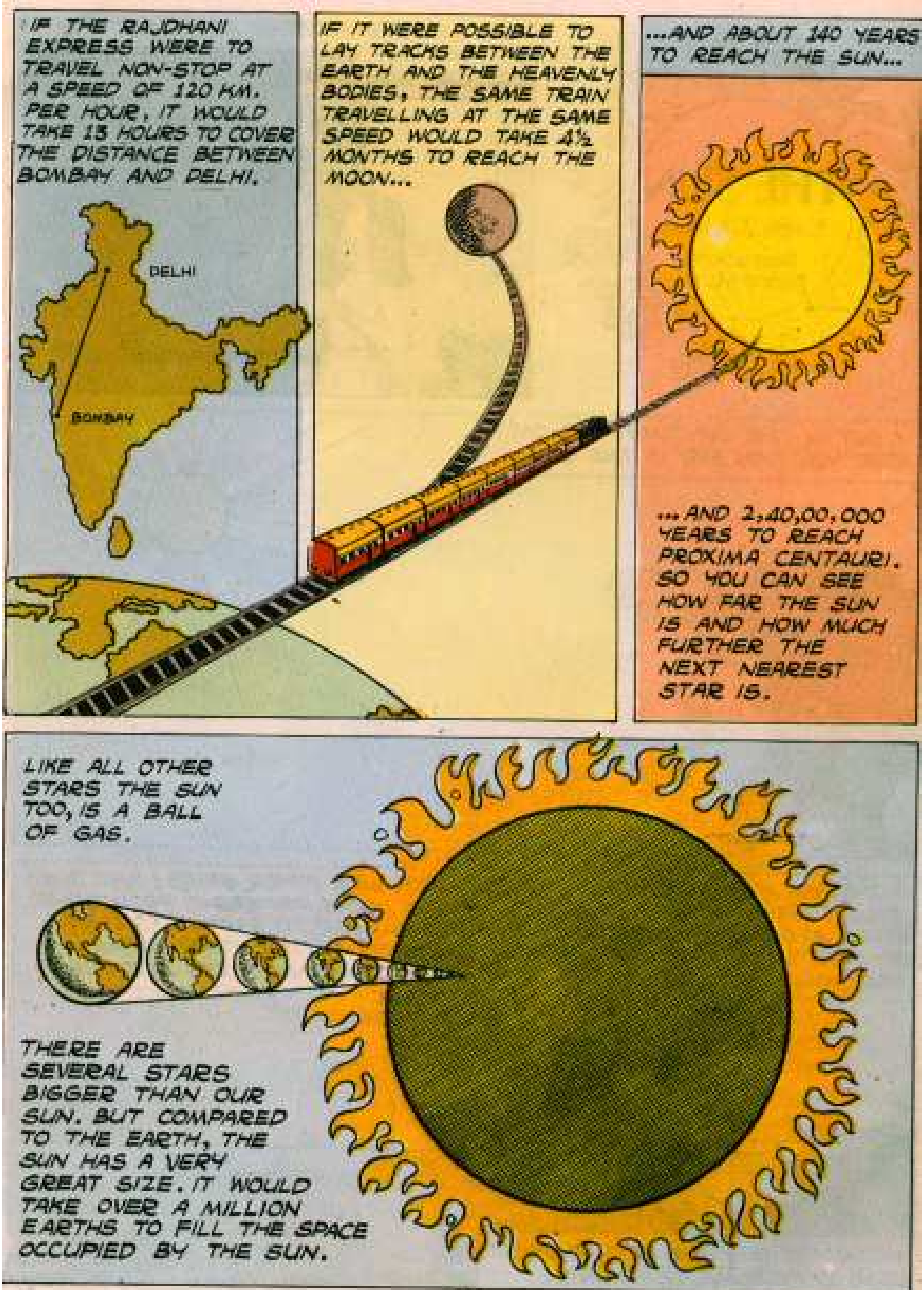
Script: J.D. Isloor Illustrations: Anand Mande

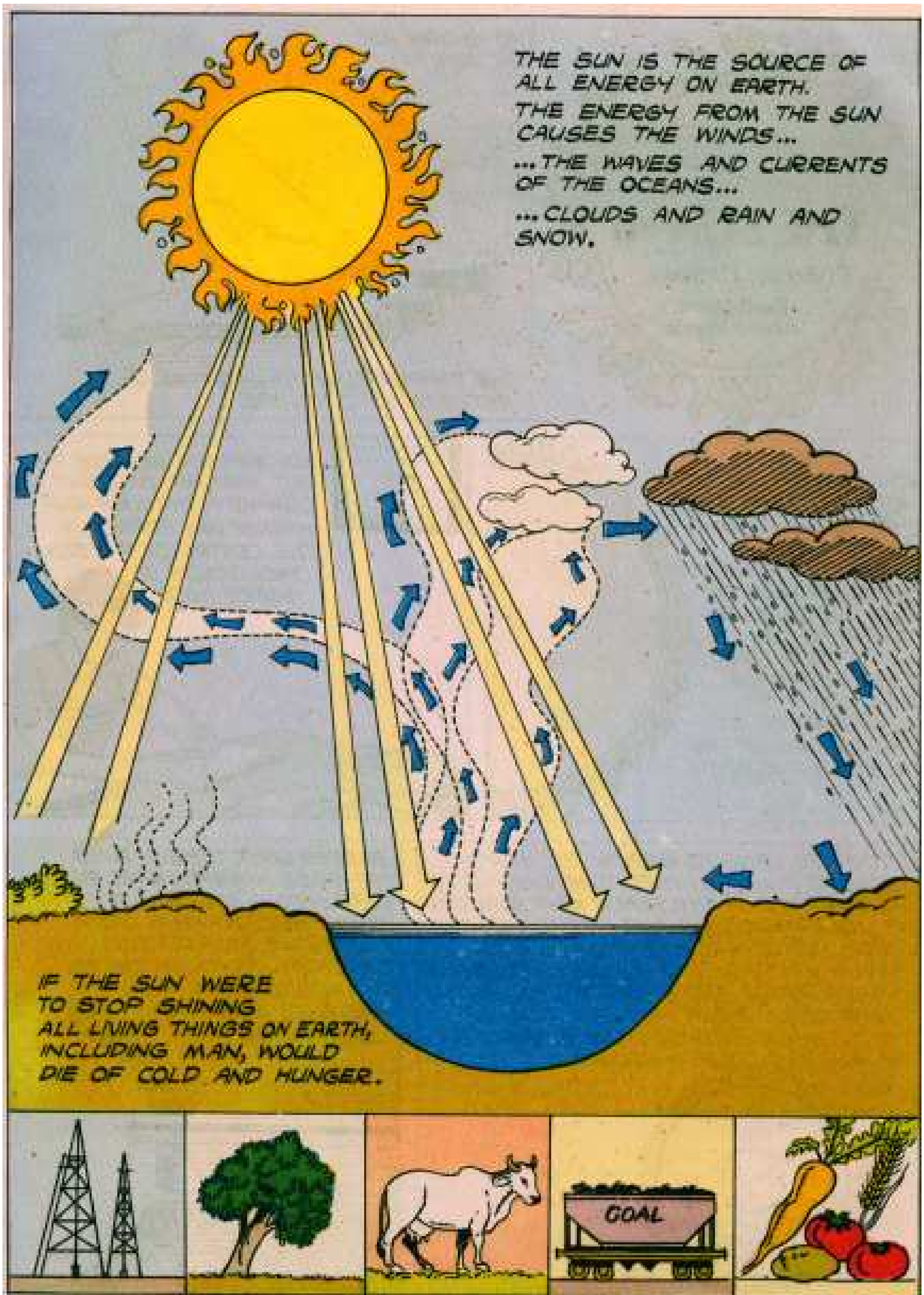


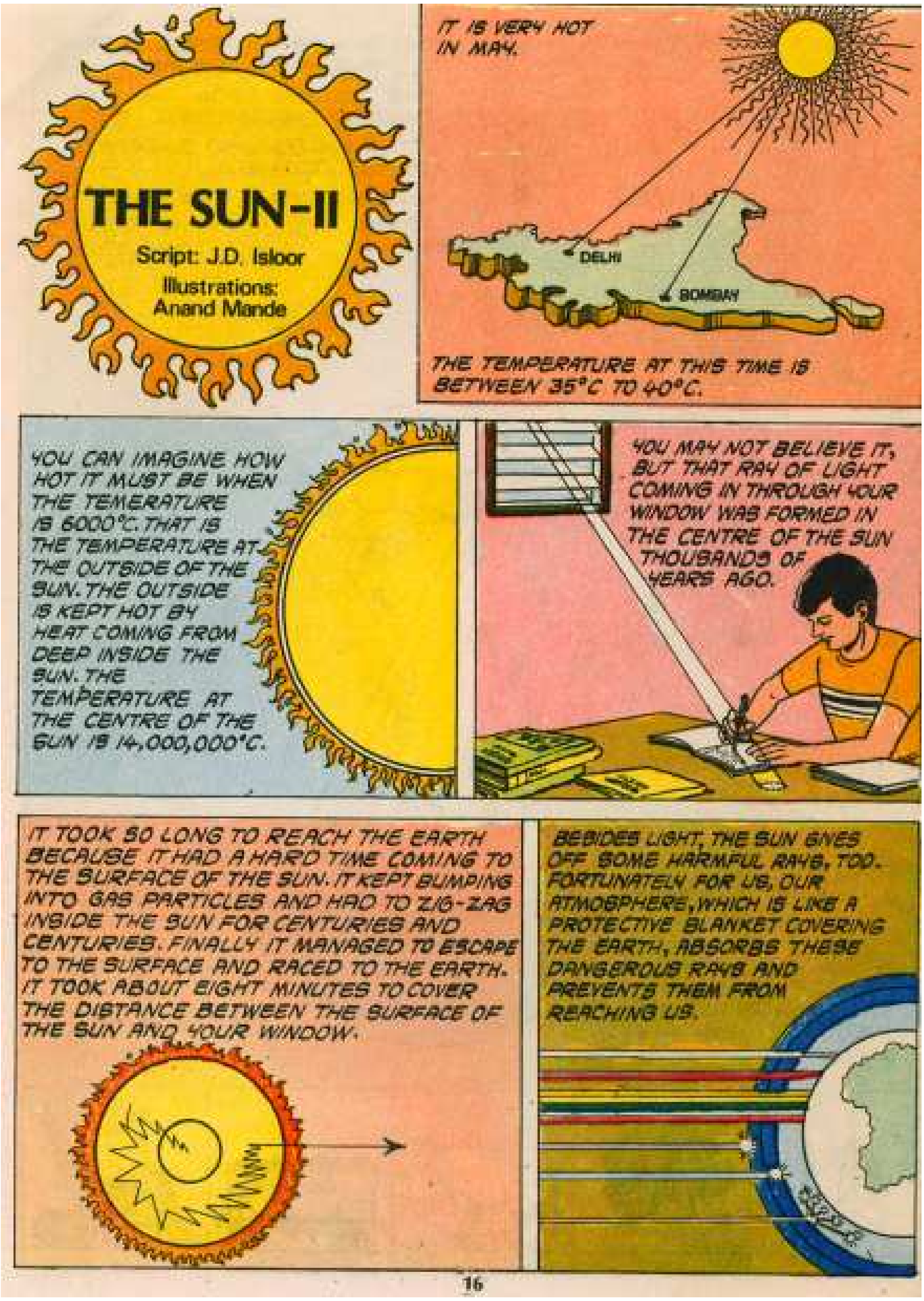

LUNA 3 WAS LAUNCHED ON OCTOBER 4, 1959. THIS SPACECRAFT TOOK PHOTOGRAPHS OF THE FAR SIDE OF THE MOON WHICH HAD NEVER BEEN SEEN BEFORE. THIS IS BECAUSE THE MOON ALWAYS HAS THE SAME SIDE TURNED TOWARDS THE EARTH.
AMERICAN ATTEMPTS TO REACH THE MOON WERE NOT SUCCESSFUL UNTIL JULY 1964 WHEN A RANGER 7 SPACECRAFT SENT BACK PICTURES BEFORE IT CRASHED ON THE MOON.
BOTH RUSSIAN AND AMERICAN SCIENTISTS BEGAN TO DESIGN SPACECRAFT THAT WOULD NOT CRASH, BUT LAND GENTLY ON THE MOON. IN 1966 THE RUSSIANS SUCCEEDED IN LANDING A SPACECRAFT GENTLY ON THE MOON. THIS SPACECRAFT, LUNA 9, SENT BACK THE FIRST CLOSE-UP PICTURES OF THE MOON'S SURFACE.

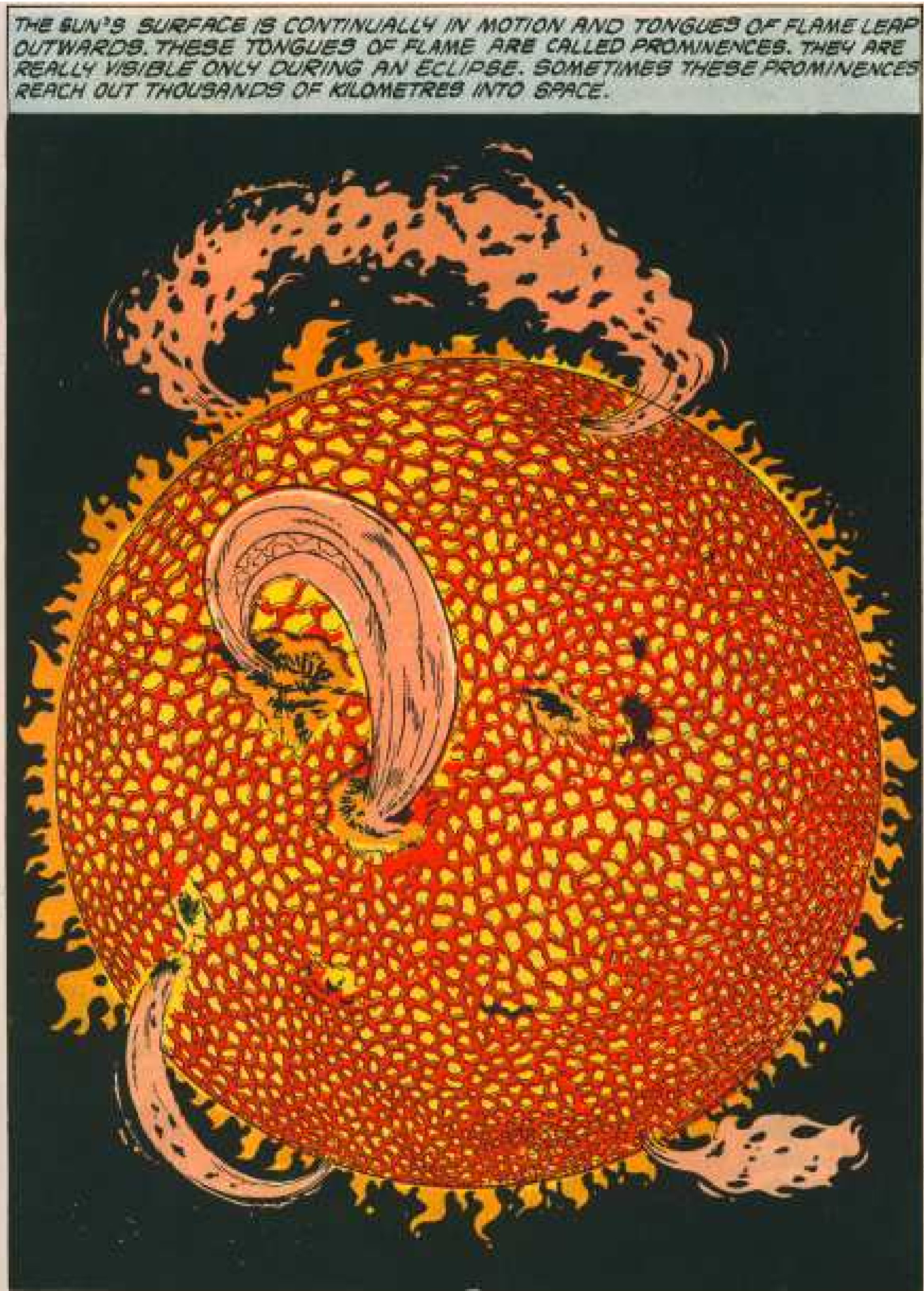

WITHIN FOUR MONTHS, THE AMERICANS ALSO SOFT-LANDED A SPACECRAFT, SURVEYOR I, ON THE MOON.
SO FAR, SPACECRAFTS HAD GONE PAST THE MOON, CRASHED ON IT AND FINALLY LANDED ON IT. NOW SPACE SCIENTISTS BEGAN TO SEND SPACECRAFTS TO CIRCLE THE MOON AND TAKE PICTURES OF THE SURFACE. LUNA 10 WAS THE FIRST SPACECRAFT TO CIRCLE THE MOON.
HOWEVER, THE AMERICANS WERE THE FIRST TO PUT A MAN ON THE MOON. THE SPACECRAFT THAT FINALLY PUT MAN ON THE MOON WAS APOLLO XI ON JULY 21, 1969. AS NEIL ARMSTRONG STEPPED ON THE MOON'S SURFACE, HIS FIRST WORDS WERE: "THAT'S ONE SMALL STEP FOR MAN, ONE GIANT LEAP FOR MANKIND."


THE SUN
Script: J.D. Isloor
Illustrations: Anand Mande
YOU CAN SEE SEVERAL STARS IN THE SKY AT NIGHT...
...BUT IN THE DAYTIME, THE ONLY STAR YOU CAN SEE IS THE SUN.
IF THE SUN IS A STAR WHY DOESN'T IT LOOK LIKE OTHER STARS! WHY DOES IT LOOK LIKE A HUGE RED BALL? THE SUN LOOKS DIFFERENT FROM OTHER STARS BECAUSE IT IS MILLIONS OF TIMES CLOSER TO EARTH THAN ANY OTHER STAR. IF OUR SUN WERE AS FAR AWAY AS THE OTHER STARS, IT TOO, WOULD HAVE APPEARED TO US AS A TWINKLING SPECK IN THE SKY.
AFTER THE SUN THE NEXT CLOSEST STAR IS PROXIMA CENTAURI.


IF THE RAJDHANI EXPRESS WERE TO TRAVEL NON-STOP AT A SPEED OF 120 KM. PER HOUR, IT WOULD TAKE 13 HOURS TO COVER THE DISTANCE BETWEEN BOMBAY AND DELHI.
DELHI
BOMBAY
IF IT WERE POSSIBLE TO LAY TRACKS BETWEEN THE EARTH AND THE HEAVENLY BODIES, THE SAME TRAIN TRAVELLING AT THE SAME SPEED WOULD TAKE 4½ MONTHS TO REACH THE MOON...
...AND ABOUT 140 YEARS TO REACH THE SUN...
...AND 2,40,00,000 YEARS TO REACH PROXIMA CENTAURI. SO YOU CAN SEE HOW FAR THE SUN IS AND HOW MUCH FURTHER THE NEXT NEAREST STAR IS.
LIKE ALL OTHER STARS THE SUN TOO, IS A BALL OF GAS.
THERE ARE SEVERAL STARS BIGGER THAN OUR SUN. BUT COMPARED TO THE EARTH, THE SUN HAS A VERY GREAT SIZE. IT WOULD TAKE OVER A MILLION EARTHS TO FILL THE SPACE OCCUPIED BY THE SUN.


THE SUN IS THE SOURCE OF ALL ENERGY ON EARTH.
THE ENERGY FROM THE SUN CAUSES THE WINDS...
...THE WAVES AND CURRENTS OF THE OCEANS...
...CLOUDS AND RAIN AND SNOW.
IF THE SUN WERE TO STOP SHINING ALL LIVING THINGS ON EARTH, INCLUDING MAN, WOULD DIE OF COLD AND HUNGER.
COAL


THE SUN-II
Script: J.D. Isloor
Illustrations: Anand Mande
IT IS VERY HOT IN MAY.
DELHI
BOMBAY
THE TEMPERATURE AT THIS TIME IS BETWEEN 35°C TO 40°C.
YOU CAN IMAGINE HOW HOT IT MUST BE WHEN THE TEMERATURE IS 6000°C. THAT IS THE TEMPERATURE AT THE OUTSIDE OF THE SUN. THE OUTSIDE IS KEPT HOT BY HEAT COMING FROM DEEP INSIDE THE SUN. THE TEMPERATURE AT THE CENTRE OF THE SUN IS 14,000,000°C.
YOU MAY NOT BELIEVE IT, BUT THAT RAY OF LIGHT COMING IN THROUGH YOUR WINDOW WAS FORMED IN THE CENTRE OF THE SUN THOUSANDS OF YEARS AGO.
IT TOOK SO LONG TO REACH THE EARTH BECAUSE IT HAD A HARD TIME COMING TO THE SURFACE OF THE SUN. IT KEPT BUMPING INTO GAS PARTICLES AND HAD TO ZIG-ZAG INSIDE THE SUN FOR CENTURIES AND CENTURIES. FINALLY IT MANAGED TO ESCAPE TO THE SURFACE AND RACED TO THE EARTH. IT TOOK ABOUT EIGHT MINUTES TO COVER THE DISTANCE BETWEEN THE SURFACE OF THE SUN AND YOUR WINDOW.
BESIDES LIGHT, THE SUN GIVES OFF SOME HARMFUL RAYS, TOO. FORTUNATELY FOR US, OUR ATMOSPHERE, WHICH IS LIKE A PROTECTIVE BLANKET COVERING THE EARTH, ABSORBS THESE DANGEROUS RAYS AND PREVENTS THEM FROM REACHING US.


THE SUN'S SURFACE IS CONTINUALLY IN MOTION AND TONGUES OF FLAME LEAP OUTWARDS. THESE TONGUES OF FLAME ARE CALLED PROMINENCES. THEY ARE REALLY VISIBLE ONLY DURING AN ECLIPSE. SOMETIMES THESE PROMINENCES REACH OUT THOUSANDS OF KILOMETRES INTO SPACE.


DISTURBANCES ON THE SUN CAN AFFECT THE EARTH TOO. ON 12TH NOVEMBER, 1960 THERE WAS A GREAT EXPLOSION ON THE SUN. SIX HOURS LATER A GIGANTIC CLOUD OF HYDROGEN GAS FLYING OUT FROM THE SUN, COLLIDED WITH THE EARTH AT A SPEED OF ABOUT 6400 KM. A SECOND.
FOR HOURS ALL LONG-DISTANCE RADIO COMMUNICATIONS WERE BLACKED OUT.
...COMPASS NEEDLES WENT HAYWIRE.
AEROPLANE PILOTS LOST CONTACT WITH THEIR GROUND STATIONS ...
IN SOME PARTS OF THE WORLD ELECTRIC LIGHTS FLICKERED AS IF IN A STORM. YET THE AIR AND SKY WERE CLEAR AND SILENT. SOME OF THE DISTURBANCES LASTED FOR MORE THAN A WEEK!


THE SUN-III
Script: J.D. Isloor
Illustrations: Anand Mande
SCHWABE WAS A SIMPLE MAN WHO WORKED THE NIGHT SHIFT AT A CHEMIST'S.
HE LOVED ASTRONOMY. HE WANTED TO STUDY THE MOON AND THE STARS. BUT YOU CANNOT STUDY THE MOON AND THE STARS DURING THE DAY AND THAT WAS THE ONLY TIME HE WAS FREE. SO HE STARTED STUDYING THE SUN INSTEAD.
AN INTERESTING FEATURE ABOUT THE SUN IS SUNSPOTS. THESE ARE DARK SPOTS WHICH APPEAR ON THE BRIGHT SURFACE OF THE SUN AND MOVE AND DISAPPEAR AFTER SEVERAL DAYS. THESE SPOTS ARE ACTUALLY AREAS WHERE THE SUN'S SURFACE IS SLIGHTLY COOLER THAN NORMAL: ABOUT 4000°C INSTEAD OF 6000°C.


SCHWABE STARTED STUDYING THESE SUNSPOTS. HE KEPT A RECORD OF HOW MANY SUNSPOTS HE SAW EVERYTIME HE LOOKED AT THE SUN.
DURING SOME YEARS HE SAW VERY FEW SPOTS, DURING OTHERS HE SAW SEVERAL. HE FOUND THAT THE GREATEST NUMBER OF SUNSPOTS COULD BE SEEN EVERY ELEVEN YEARS. THIS DISCOVERY WAS OF GREAT IMPORTANCE TO ASTRONOMERS.
SUNSPOTS SOMETIMES INTERFERE WITH RADIO PROGRAMMES ON EARTH. AND SCIENTISTS SAY THEY AFFECT OUR WEATHER TOO.
BUT SUNSPOTS CERTAINLY HELPED SCIENTISTS TO LEARN SOMETHING ABOUT THE SUN. BY WATCHING THE POSITIONS OF THE SUNSPOTS ON THE SURFACE OF THE SUN, THEY FOUND OUT THAT THE SUN SPINS ON ITS AXIS.
THE SUN IS SPINNING THAT IS WHY THE SPOTS SEEM TO HAVE SHIFTED POSITIONS

OUR SOLAR SYSTEM—1

Script: J.D. Isloor
Illustrations: Anand Mande

THERE ARE MANY MANY GALAXIES IN THE UNIVERSE.
ONE OF THEM WE CALL THE MILKY WAY.
THE MILKY WAY IS MADE UP OF COUNTLESS OF STARS.
AT ITS CENTRE, THE STARS ARE PACKED CLOSELY TOGETHER.
BUT THE STARS BECOME FEWER TOWARDS THE EDGE. TWO-THIRDS AWAY FROM THE CENTRE THERE IS AN ORDINARY, YELLOWISH STAR. THIS STAR IS OUR SUN AROUND WHICH OUR EARTH AND THE OTHER PLANETS REVOLVE.




FIVE PLANETS CAN BE SEEN WITH THE NAKED EYE.
SO IN ANCIENT TIMES AND EVEN AS LATE AS THE 18TH CENTURY PEOPLE THOUGHT THERE WERE ONLY FIVE OTHER PLANETS BESIDES EARTH.


EVERYONE WAS, THEREFORE, VERY SURPRISED WHEN AN ASTRONOMER NAMED HERSCHEL DISCOVERED A SEVENTH PLANET, URANUS, IN 1781.
URANUS AS IT MIGHT APPEAR FROM ITS SATELITE TITANIA
HERSCHEL DISCOVERED URANUS WITH A HUGE TELESCOPE HE HAD CONSTRUCTED.

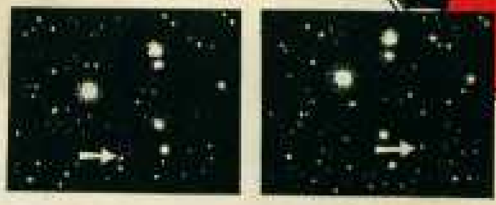
YET ANOTHER PLANET WAS DISCOVERED IN 1846. IT WAS NAMED NEPTUNE.



NEPTUNE AND ITS TWO MOONS

IN 1930 A YOUNG ASTRONOMER NAMED CLYDE TOMBAUGH, DISCOVERED A NINTH PLANET. IT WAS NAMED PLUTO. CLYDE TOMBAUGH FOUND PLUTO BY STUDYING THOUSANDS OF PHOTOGRAPHS OF THE REGION OF THE SKY IN WHICH OTHER ASTRONOMERS HAD PREDICTED THAT PLUTO WOULD BE FOUND.





THE PLANETS

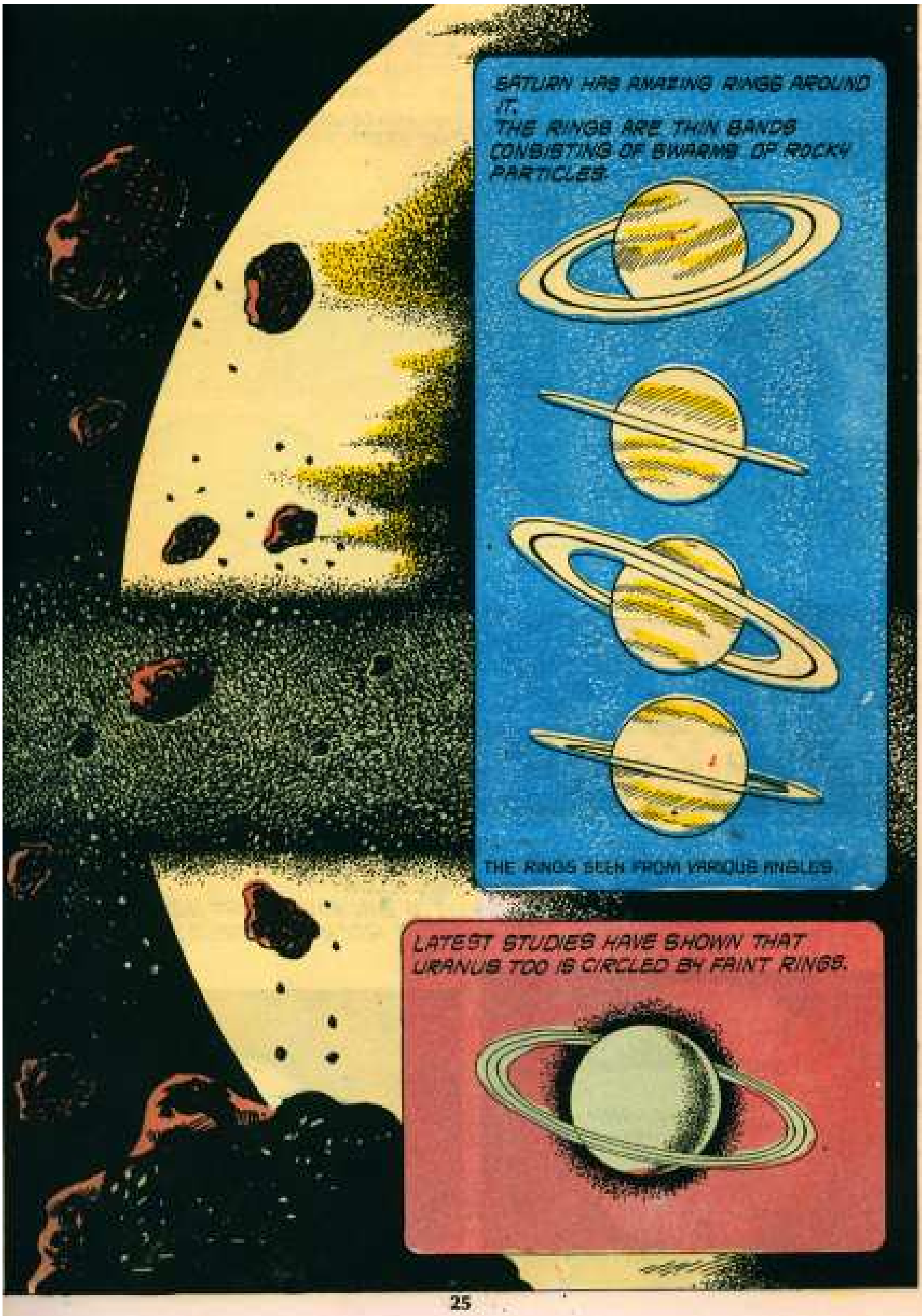


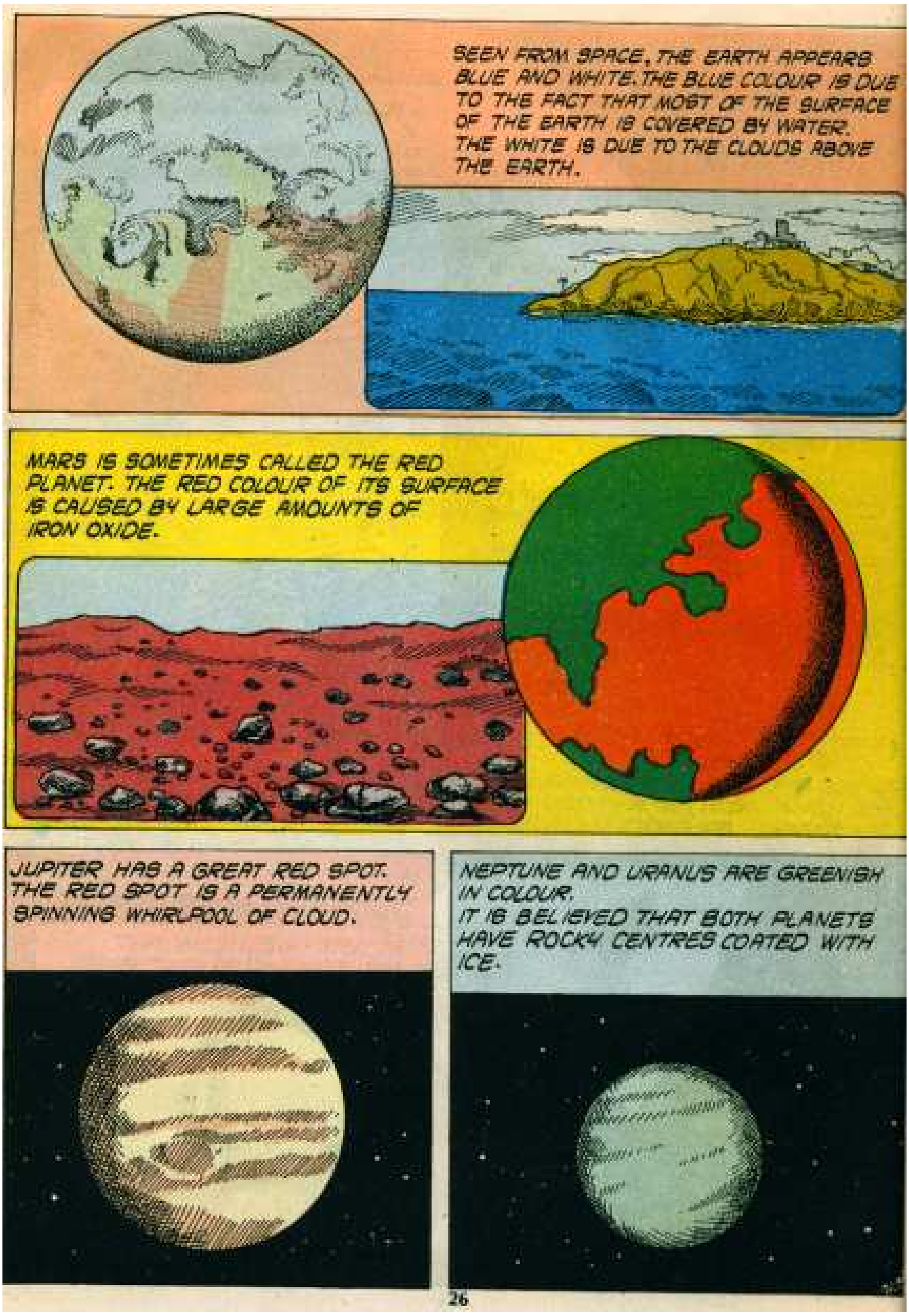
NAME IN ENGLISH	INDIAN NAME	YEAR OF DISCOVERY —
MERCURY	BUDHA	ANCIENT
VENUS	SHUKRA	ANCIENT
EARTH	BHUMANDAL PRITHVI	ANCIENT
MARS	MANGALA	ANCIENT
JUPITER	GURU BRIHASPATI	ANCIENT
SATURN	SHANI	ANCIENT
URANUS		1781
NEPTUNE		1846
PLUTO		1930

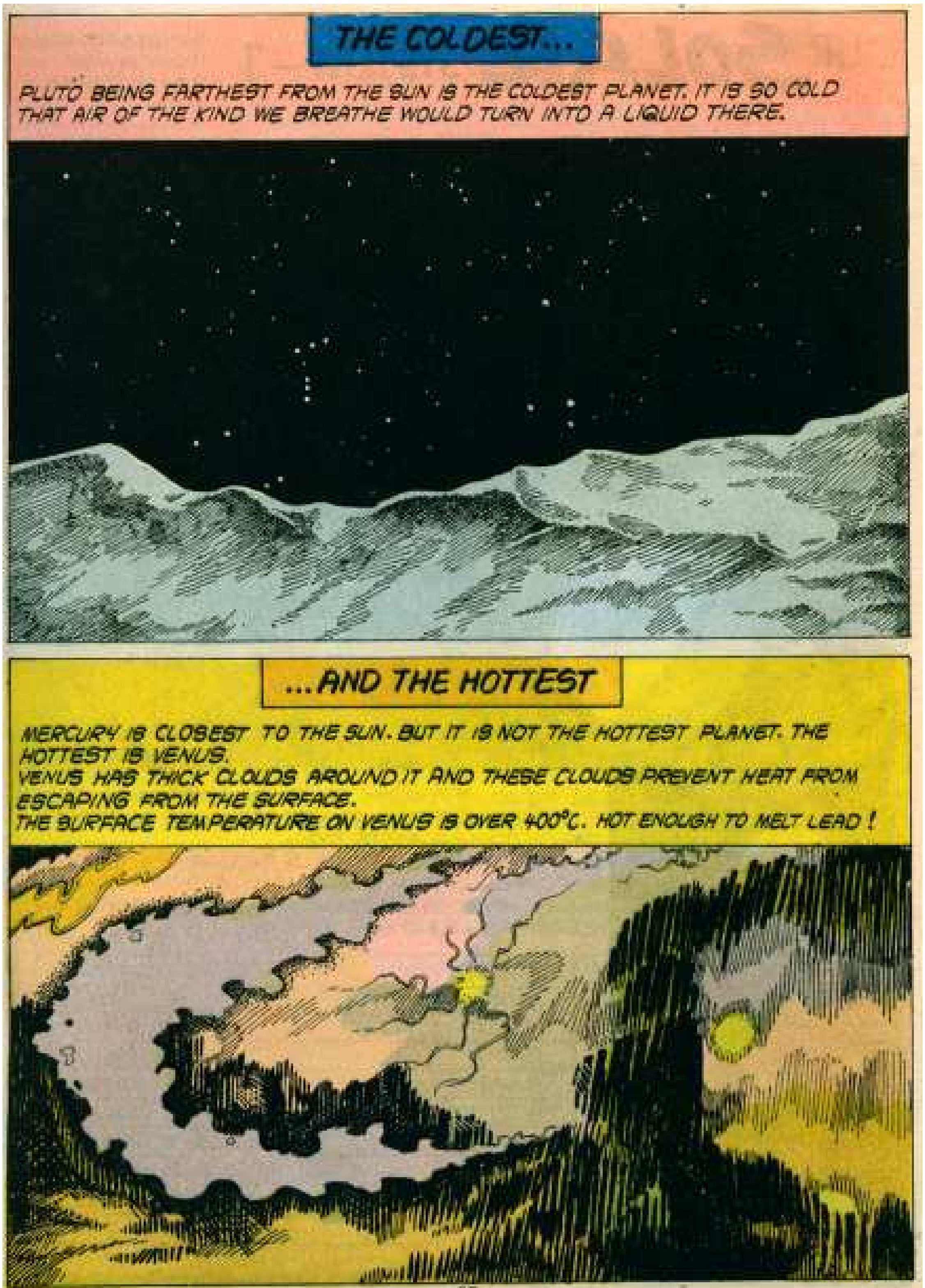
OUR SOLAR SYSTEM—2

Script: J.D. Isloor
Illustrations: Anand Mande




SATURN HAS AMAZING RINGS AROUND IT.
THE RINGS ARE THIN BANDS CONSISTING OF SWARMS OF ROCKY PARTICLES.
THE RINGS SEEN FROM VARIOUS ANGLES.
LATEST STUDIES HAVE SHOWN THAT URANUS TOO IS CIRCLED BY FAINT RINGS.

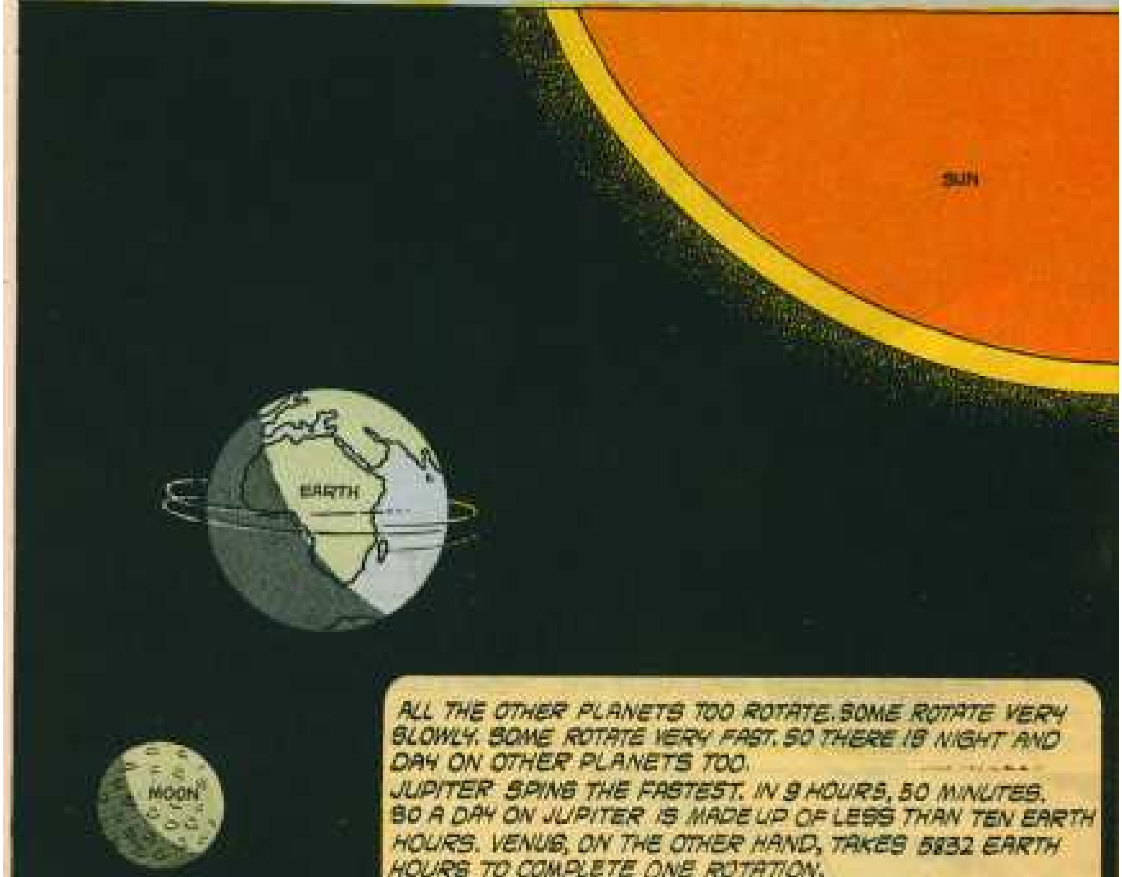

SEEN FROM SPACE, THE EARTH APPEARS BLUE AND WHITE. THE BLUE COLOUR IS DUE TO THE FACT THAT MOST OF THE SURFACE OF THE EARTH IS COVERED BY WATER. THE WHITE IS DUE TO THE CLOUDS ABOVE THE EARTH.
MARS IS SOMETIMES CALLED THE RED PLANET. THE RED COLOUR OF ITS SURFACE IS CAUSED BY LARGE AMOUNTS OF IRON OXIDE.
JUPITER HAS A GREAT RED SPOT. THE RED SPOT IS A PERMANENTLY SPINNING WHIRLPOOL OF CLOUD.
NEPTUNE AND URANUS ARE GREENISH IN COLOUR. IT IS BELIEVED THAT BOTH PLANETS HAVE ROCKY CENTRES COATED WITH ICE.


THE COLDEST...
PLUTO BEING FARTHEST FROM THE SUN IS THE COLDEST PLANET. IT IS SO COLD THAT AIR OF THE KIND WE BREATHE WOULD TURN INTO A LIQUID THERE.
...AND THE HOTTEST
MERCURY IS CLOSEST TO THE SUN. BUT IT IS NOT THE HOTTEST PLANET. THE HOTTEST IS VENUS.
VENUS HAS THICK CLOUDS AROUND IT AND THESE CLOUDS PREVENT HEAT FROM ESCAPING FROM THE SURFACE.
THE SURFACE TEMPERATURE ON VENUS IS OVER 400°C. HOT ENOUGH TO MELT LEAD !

OUR SOLAR SYSTEM—3

Script: J.D. Isloor
Illustrations: Anand Mande

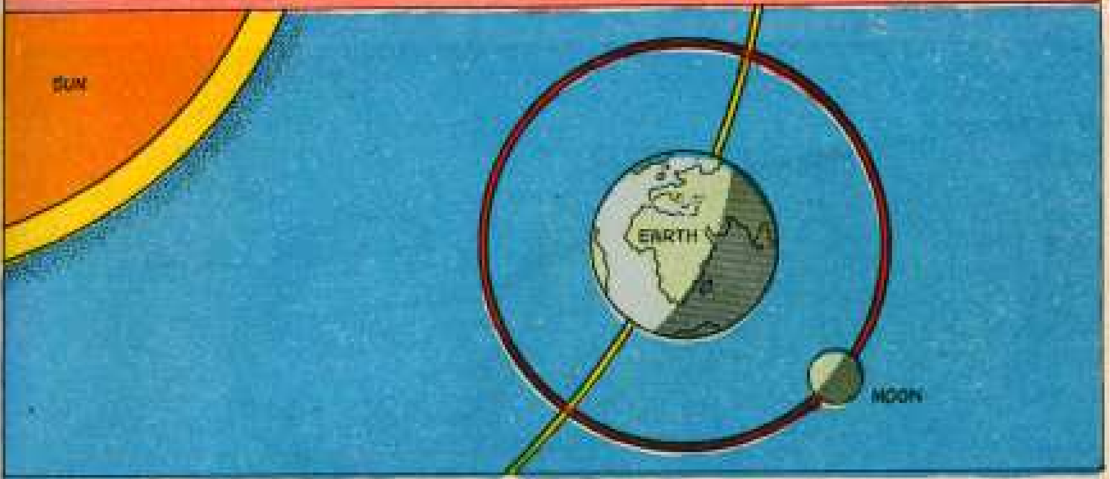
THE EARTH SPINS LIKE A TOP. IN OTHER WORDS, IT ROTATES.
AS IT SPINS, THE PART TURNED TOWARDS THE SUN IS LIGHTED UP WHILE THE PART ON THE OTHER SIDE IS DARK.
IT IS BECAUSE THE EARTH SPINS THAT WE HAVE DAY AND NIGHT.



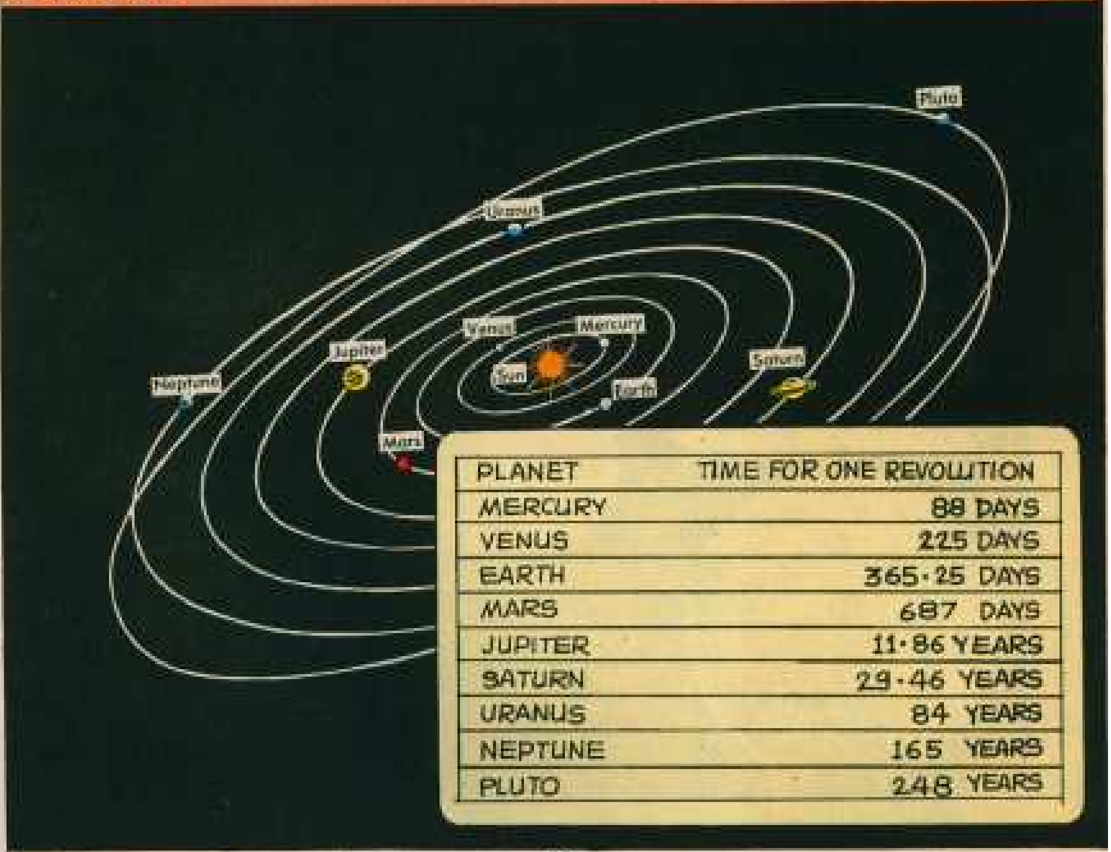
ALL THE OTHER PLANETS TOO ROTATE. SOME ROTATE VERY SLOWLY. SOME ROTATE VERY FAST. SO THERE IS NIGHT AND DAY ON OTHER PLANETS TOO.
JUPITER SPINS THE FASTEST. IN 9 HOURS, 50 MINUTES. SO A DAY ON JUPITER IS MADE UP OF LESS THAN TEN EARTH HOURS. VENUS, ON THE OTHER HAND, TAKES 5832 EARTH HOURS TO COMPLETE ONE ROTATION.

PLANET	TIME FOR ONE ROTATION
MERCURY	59 DAYS
VENUS	243 DAYS
EARTH	23·93 HOURS
MARS	24·6 HOURS
JUPITER	9·9 HOURS
SATURN	10·7 HOURS
URANUS	15·6(?) HOURS
NEPTUNE	17·9 HOURS
PLUTO	6·4 EARTH DAYS

ANOTHER THING WHICH ALL THE PLANETS INCLUDING EARTH DO IS MAKE A TRIP AROUND THE SUN. ONE COMPLETE TRIP OF A PLANET AROUND THE SUN IS CALLED ONE REVOLUTION. EARTH TAKES 365 DAYS TO COMPLETE THE TRIP. THAT MEANS THAT AS IT MOVES AROUND THE SUN ONCE, THE EARTH SPINS 365 TIMES.

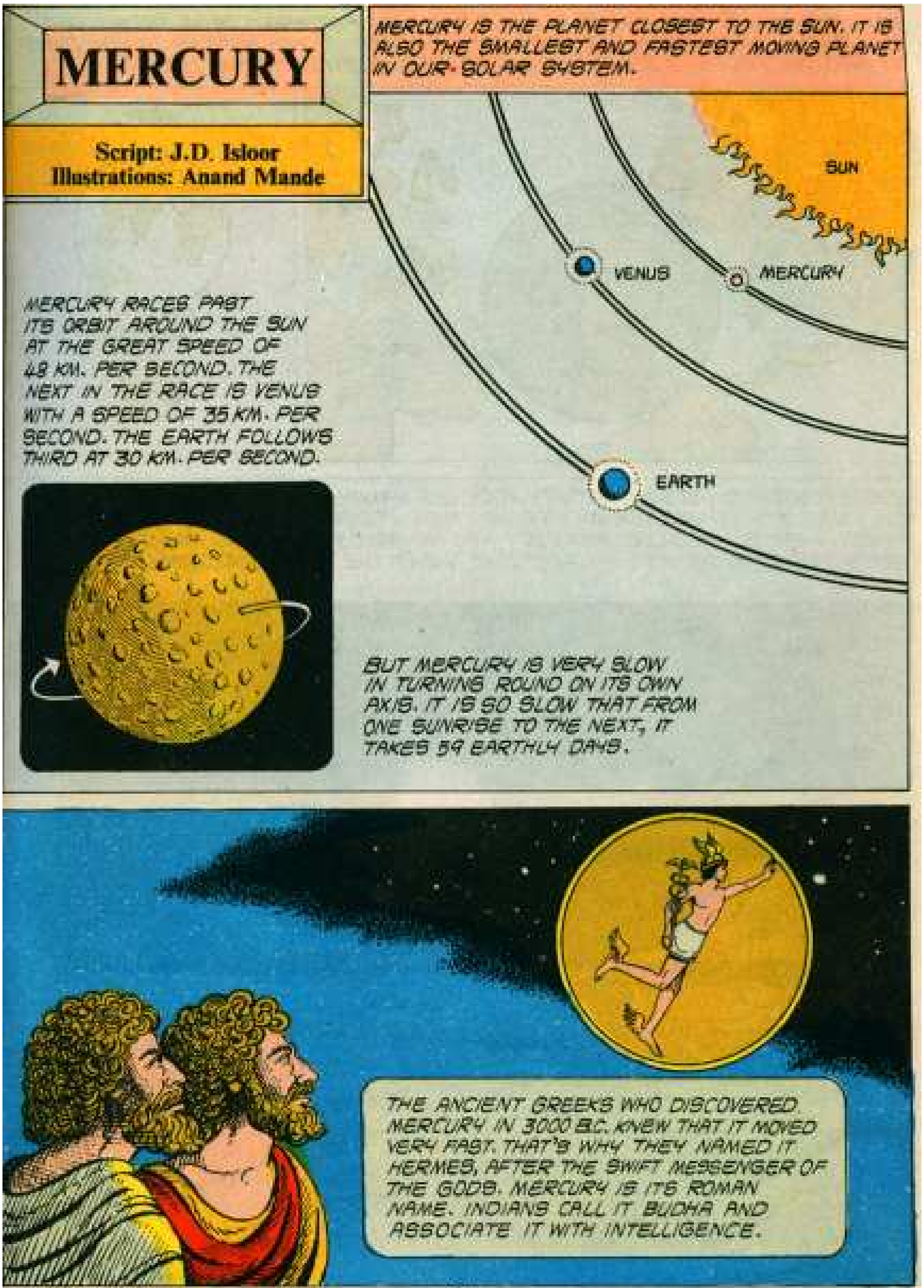


MERCURY TAKES ONLY 88 EARTH DAYS TO GO AROUND THE SUN.
PLUTO IS A SLOW-COACH. IT TAKES ALMOST 250 EARTH YEARS TO COMPLETE ONE REVOLUTION.

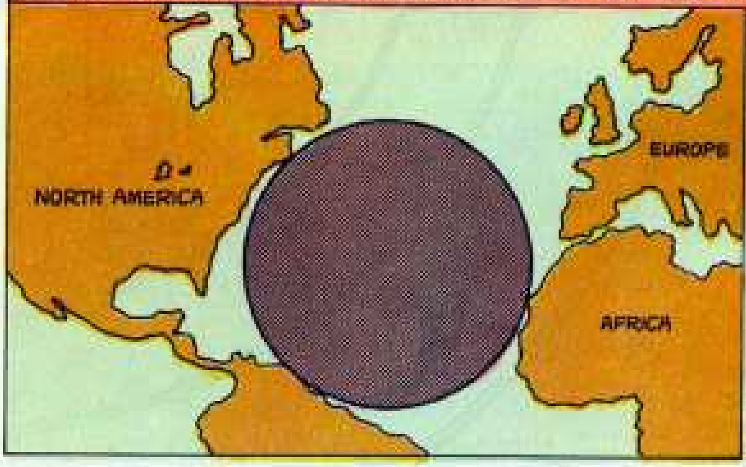


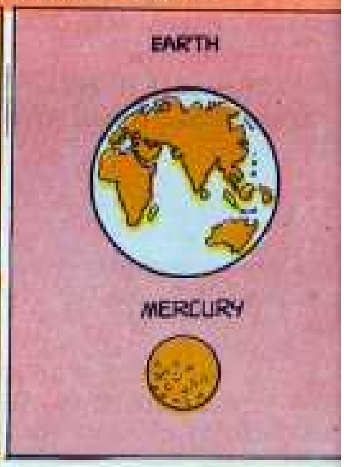
PLANET	TIME FOR ONE REVOLUTION
MERCURY	88 DAYS
VENUS	225 DAYS
EARTH	365·25 DAYS
MARS	687 DAYS
JUPITER	11·86 YEARS
SATURN	29·46 YEARS
URANUS	84 YEARS
NEPTUNE	165 YEARS
PLUTO	248 YEARS


BETWEEN MARS AND JUPITER THERE ARE THOUSANDS OF MINOR PLANETS.
THEY ARE CALLED PLANETOIDS OR ASTEROIDS.
SOME OF THEM ARE NO BIGGER THAN HOUSES. OTHERS ARE LARGER.
THE LARGEST, CERES, IS ONLY ABOUT 800 KILOMETRES WIDE.
JUPITER
MARS
CERES IS VERY MUCH SMALLER THAN OUR MOON.
CERES


MERCURY
Script: J.D. Isloor
Illustrations: Anand Mande
MERCURY IS THE PLANET CLOSEST TO THE SUN. IT IS ALSO THE SMALLEST AND FASTEST MOVING PLANET IN OUR SOLAR SYSTEM.
SUN
VENUS
MERCURY
EARTH
MERCURY RACES PAST ITS ORBIT AROUND THE SUN AT THE GREAT SPEED OF 48 KM. PER SECOND. THE NEXT IN THE RACE IS VENUS WITH A SPEED OF 35 KM. PER SECOND. THE EARTH FOLLOWS THIRD AT 30 KM. PER SECOND.
BUT MERCURY IS VERY SLOW IN TURNING ROUND ON ITS OWN AXIS. IT IS SO SLOW THAT FROM ONE SUNRISE TO THE NEXT, IT TAKES 59 EARTHLY DAYS.
THE ANCIENT GREEKS WHO DISCOVERED MERCURY IN 3000 B.C. KNEW THAT IT MOVED VERY FAST. THAT'S WHY THEY NAMED IT HERMES, AFTER THE SWIFT MESSENGER OF THE GODS. MERCURY IS ITS ROMAN NAME. INDIANS CALL IT BUDHA AND ASSOCIATE IT WITH INTELLIGENCE.

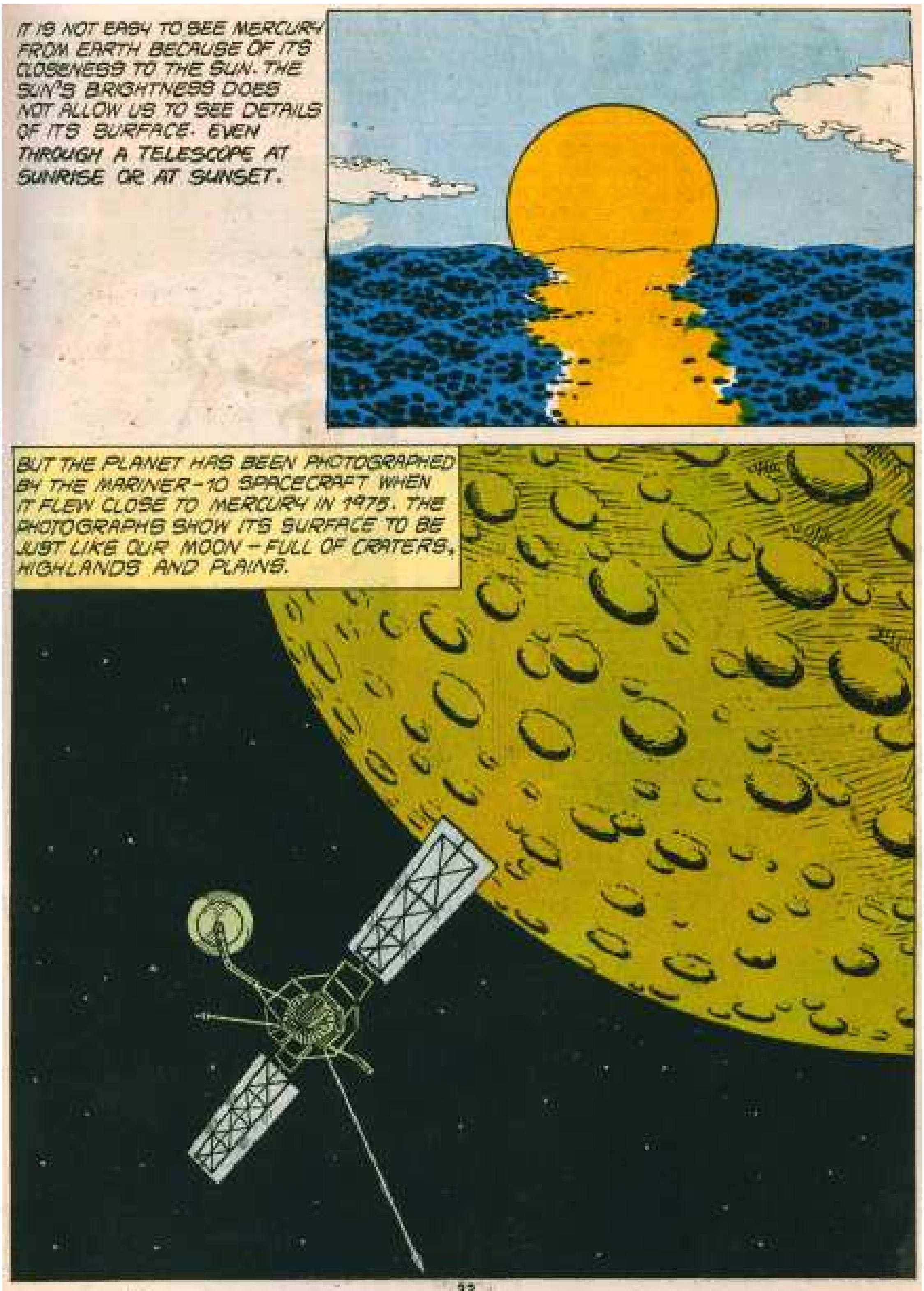
MERCURY IS ABOUT THE SIZE OF PLUTO, THE PLANET FARTHEST FROM THE SUN, AND IS SLIGHTLY LARGER THAN OUR MOON. ITS DIAMETER IS ONLY 4850 KM. IT WOULD JUS FIT INTO THE ATLANTIC OCEAN WERE IT TO BE BROUGHT ON TO THE EARTH.





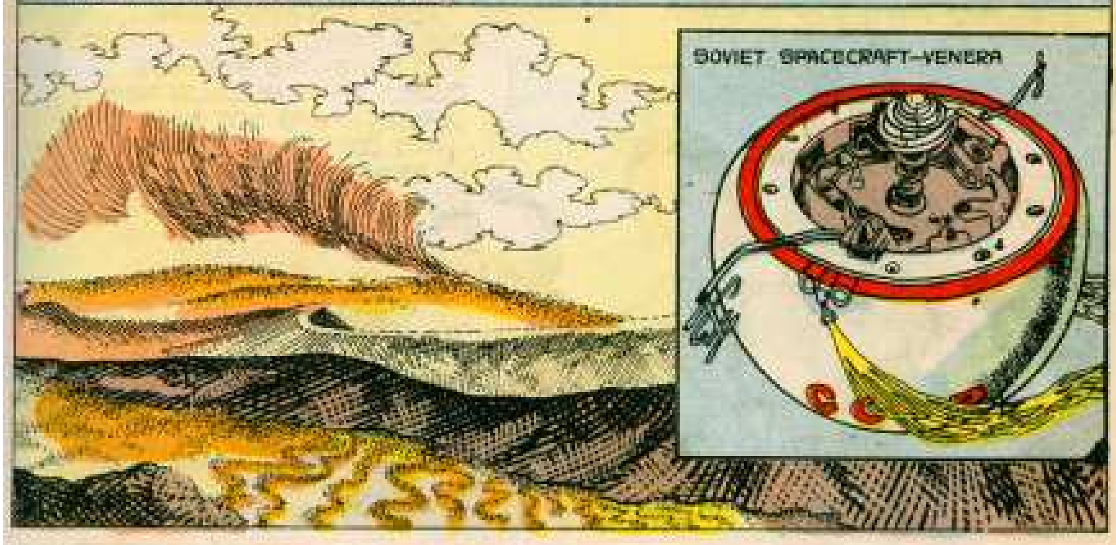
BEING CLOSEST TO THE SUN, MERCURY RECEIVES MAXIMUM HEAT AND LIGHT. AND THE SUN LOOKS 3 TIMES BIGGER ON MERCURY THAN IT DOES TO US ON EARTH. THE SUN SHINES FIERCELY BECAUSE MERCURY HAS NO ATMOSPHERE AND ITS DAY-TIME TEMPERATURE IS AS HIGH AS 400°C. AT NIGHT THE TEMPERATURE DROPS TO −200°C.



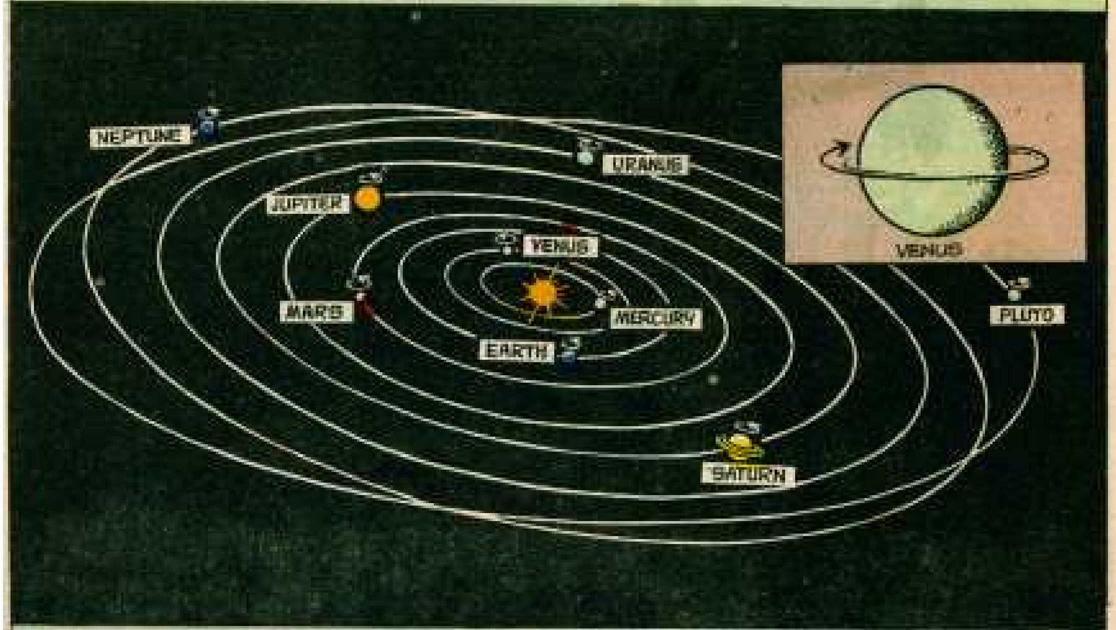

IT IS NOT EASY TO SEE MERCURY FROM EARTH BECAUSE OF ITS CLOSENESS TO THE SUN. THE SUN'S BRIGHTNESS DOES NOT ALLOW US TO SEE DETAILS OF ITS SURFACE. EVEN THROUGH A TELESCOPE AT SUNRISE OR AT SUNSET.
BUT THE PLANET HAS BEEN PHOTOGRAPHED BY THE MARINER-10 SPACECRAFT WHEN IT FLEW CLOSE TO MERCURY IN 1975. THE PHOTOGRAPHS SHOW ITS SURFACE TO BE JUST LIKE OUR MOON — FULL OF CRATERS, HIGHLANDS AND PLAINS.


VENUS
Script : J.D. Isloor
Illustrations : Anand Mande
VENUS IS THE SECOND PLANET AWAY FROM THE SUN, AND AFTER THE MOON, IT IS THE BRIGHTEST HEAVENLY BODY IN OUR NIGHT SKY.
EARTH
MERCURY
VENUS
BECAUSE OF ITS BRIGHTNESS AND BEAUTY, THIS PLANET WAS NAMED AFTER THE GODDESS OF LOVE, VENUS, AS LONG AS 5000 YEARS AGO. ANCIENT INDIANS CALLED IT "SHUKRA" AFTER THE GURU OF ASURAS.
ONLY UNTIL RECENTLY, VENUS AND EARTH WERE BELIEVED TO BE TWINS BECAUSE BOTH ARE ALMOST THE SAME SIZE. BUT THE SIMILARITY ENDS THERE.
IT IS DIFFICULT TO SEE THE SURFACE OF VENUS EVEN THROUGH A POWERFUL TELESCOPE BECAUSE IT IS COVERED WITH CLOUDS ABOUT 20 KM. THICK. THESE CLOUDS ARE MADE UP OF GASES THAT DO NOT SUPPORT LIFE. THE ATMOSPHERIC PRESSURE IS A HUNDRED TIMES THAT ON EARTH. SO THERE CAN BE NO LIFE ON VENUS AS WE KNOW IT, THOUGH ANCIENT ASTRONOMERS THOUGHT THERE WERE REPTILES AND PLANTS ON THE PLANET.

THE TEMPERATURE ON VENUS IS VERY HIGH (800°C). THAT IS WHY WHEN EARLY SOVIET PROBES APPROACHED VENUS, THEY WERE VAPOURISED. HOWEVER, LATER PROBES HAVE ACTUALLY LANDED ON THE PLANET AND SENT BACK PHOTOGRAPHS. THE SURFACE IS BARREN AND STREWN WITH ROCKS.



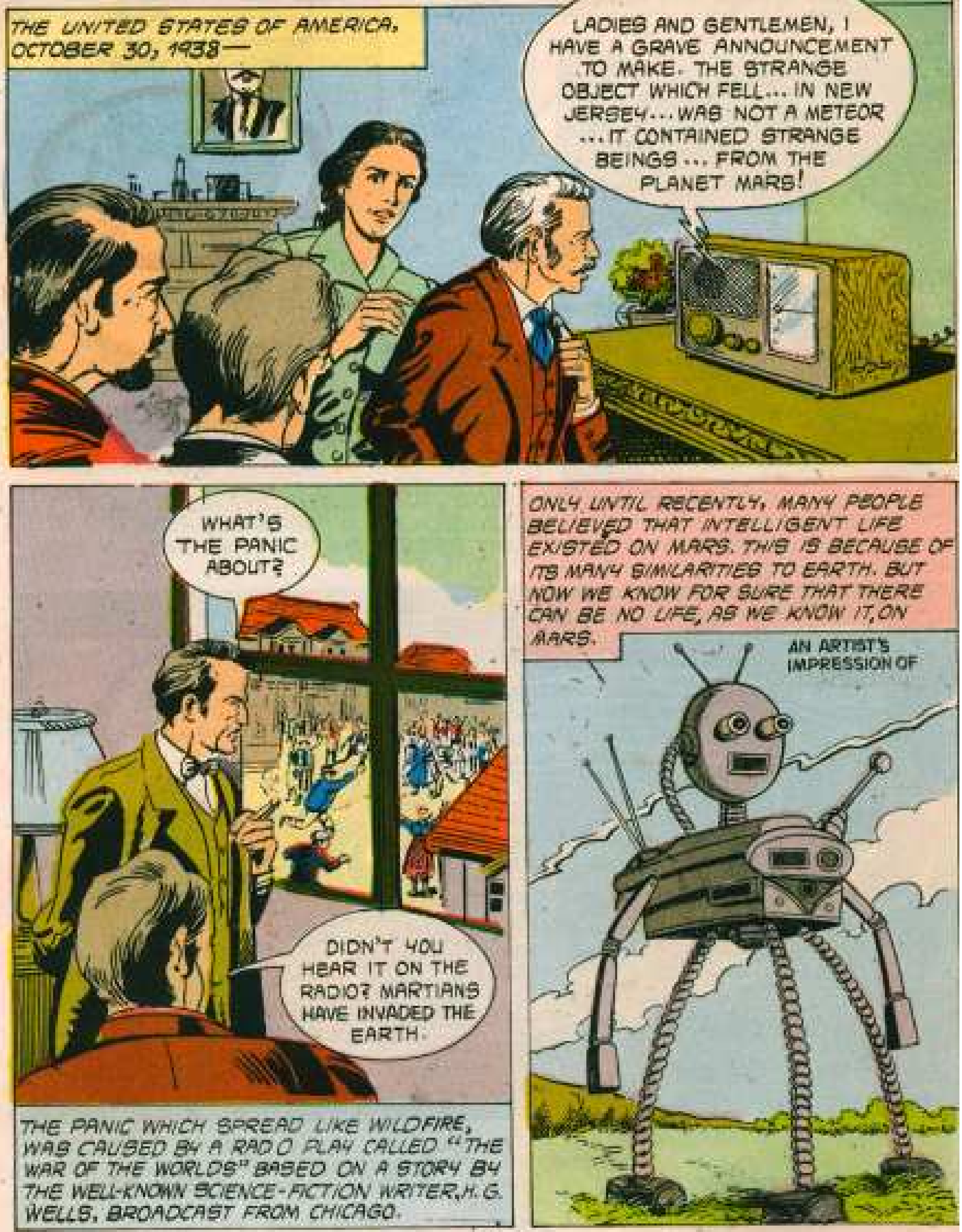
IF YOU VIEW THE SOLAR SYSTEM FROM ABOVE, YOU WILL SEE THAT ALL PLANETS ROTATE IN COUNTER-CLOCKWISE DIRECTION. ONLY VENUS AND URANUS ROTATE CLOCKWISE. THAT IS WHY ON VENUS, THE SUN RISES IN THE WEST AND SETS IN THE EAST.

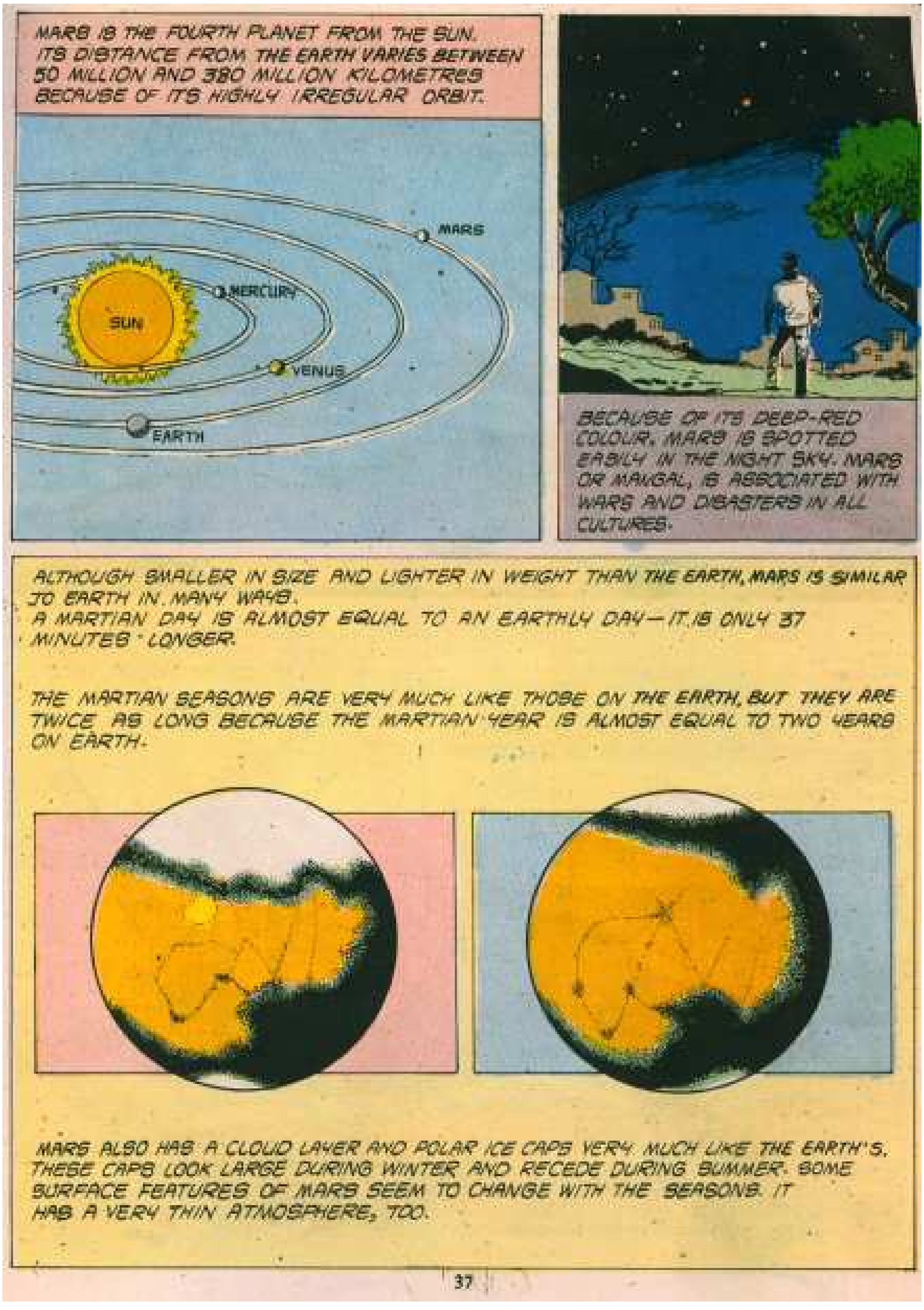


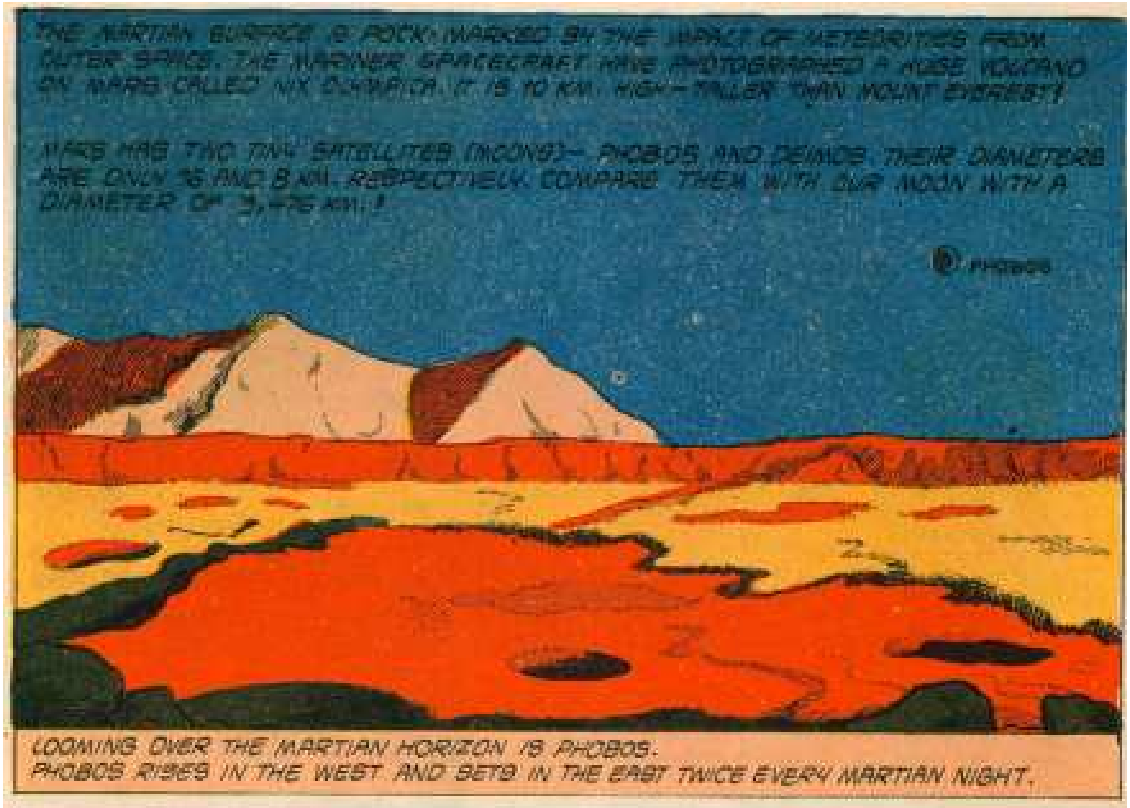
IT IS INTERESTING TO KNOW THAT A 'DAY' ON VENUS IS LONGER THAN ITS 'YEAR'. WHILE VENUS TAKES 225 EARTHLY DAYS TO GO ROUND THE SUN (EARTH TAKES 365), IT TAKES AS MANY AS 243 EARTHLY DAYS TO GO AROUND ITS AXIS ONCE (EARTH TAKES 24 HOURS). VENUS HAS NO MOONS OF ITS OWN.

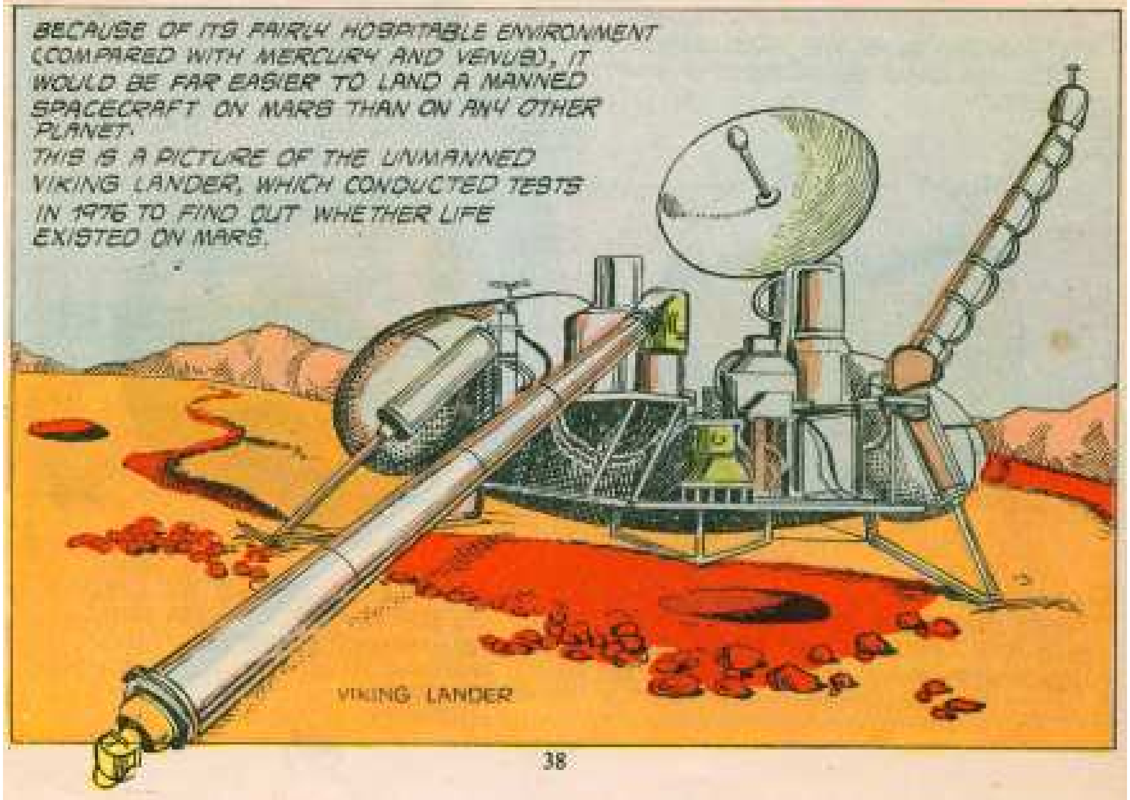
MARS

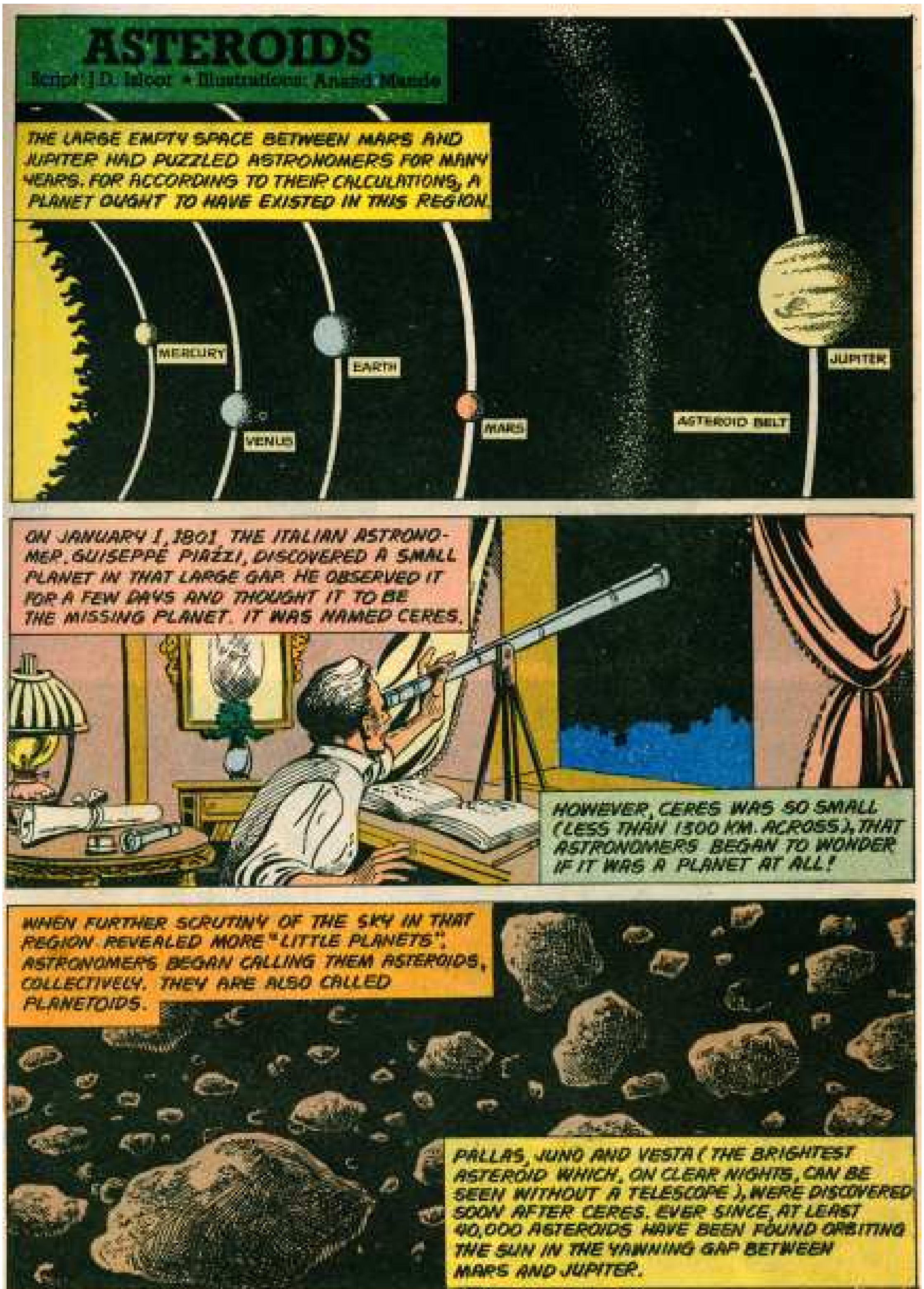
Script: J.D. Isloor
Illustrations: Anand Mande



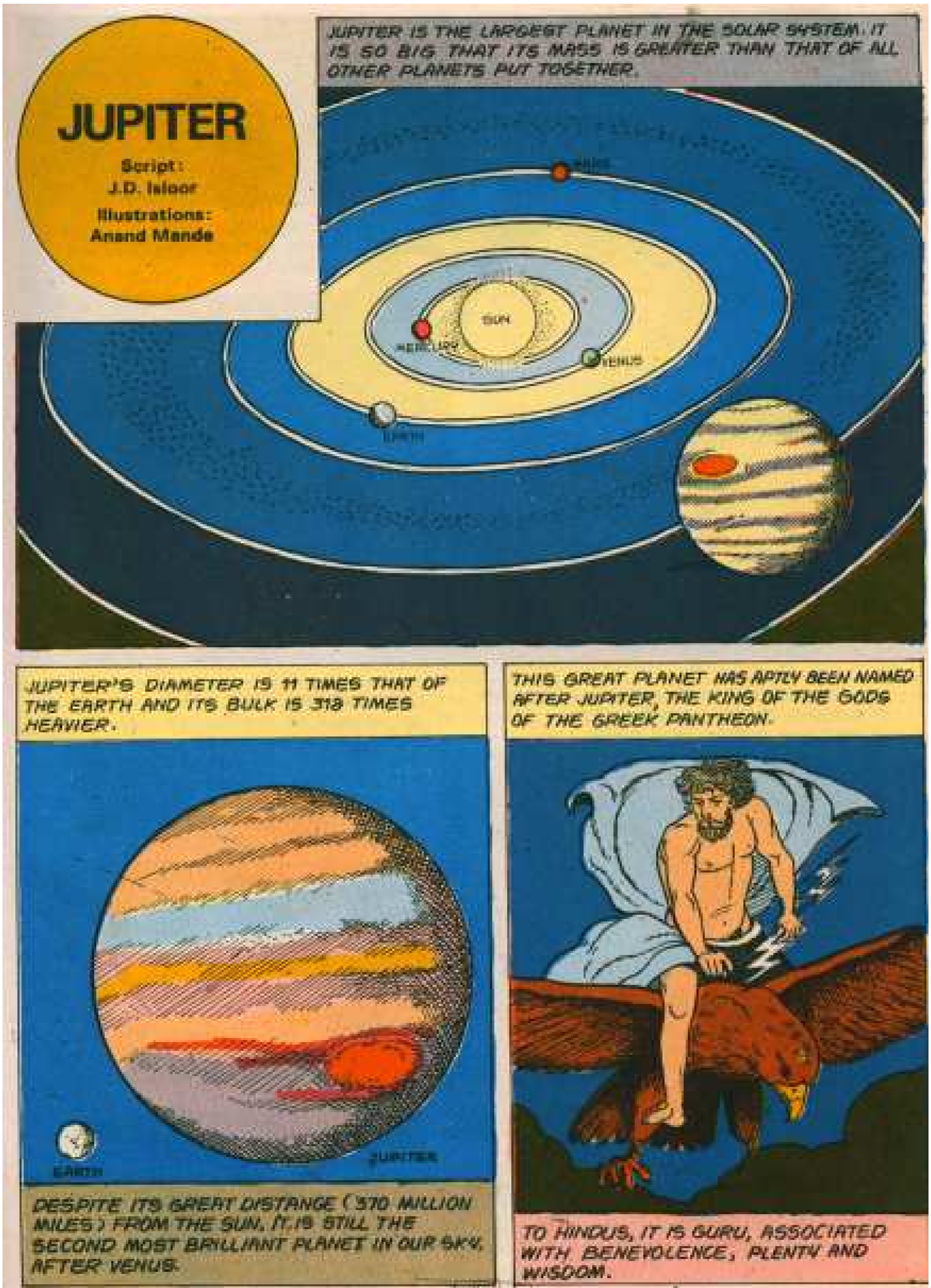

MARS IS THE FOURTH PLANET FROM THE SUN. ITS DISTANCE FROM THE EARTH VARIES BETWEEN 50 MILLION AND 380 MILLION KILOMETRES BECAUSE OF IT'S HIGHLY IRREGULAR ORBIT.
MARS
MERCURY
SUN
VENUS
EARTH
BECAUSE OF ITS DEEP-RED COLOUR, MARS IS SPOTTED EASILY IN THE NIGHT SKY. MARS OR MANGAL, IS ASSOCIATED WITH WARS AND DISASTERS IN ALL CULTURES.
ALTHOUGH SMALLER IN SIZE AND LIGHTER IN WEIGHT THAN THE EARTH, MARS IS SIMILAR TO EARTH IN MANY WAYS.
A MARTIAN DAY IS ALMOST EQUAL TO AN EARTHLY DAY—IT IS ONLY 37 MINUTES LONGER.
THE MARTIAN SEASONS ARE VERY MUCH LIKE THOSE ON THE EARTH, BUT THEY ARE TWICE AS LONG BECAUSE THE MARTIAN YEAR IS ALMOST EQUAL TO TWO YEARS ON EARTH.
MARS ALSO HAS A CLOUD LAYER AND POLAR ICE CAPS VERY MUCH LIKE THE EARTH'S. THESE CAPS LOOK LARGE DURING WINTER AND RECEDE DURING SUMMER. SOME SURFACE FEATURES OF MARS SEEM TO CHANGE WITH THE SEASONS. IT HAS A VERY THIN ATMOSPHERE, TOO.


THE MARTIAN SURFACE IS ROCKY, MARKED BY THE IMPACT OF METEORITES FROM OUTER SPACE. THE MARINER SPACECRAFT HAVE PHOTOGRAPHED A HUGE VOLCANO ON MARS CALLED NIX OLYMPICA. IT IS 10 KM. HIGH—TALLER THAN MOUNT EVEREST!
MARS HAS TWO TINY SATELLITES (MOONS)— PHOBOS AND DEIMOS. THEIR DIAMETERS ARE ONLY 16 AND 8 KM. RESPECTIVELY. COMPARE THEM WITH OUR MOON WITH A DIAMETER OF 3,476 KM.!
PHOBOS
LOOMING OVER THE MARTIAN HORIZON IS PHOBOS.
PHOBOS RISES IN THE WEST AND SETS IN THE EAST TWICE EVERY MARTIAN NIGHT.

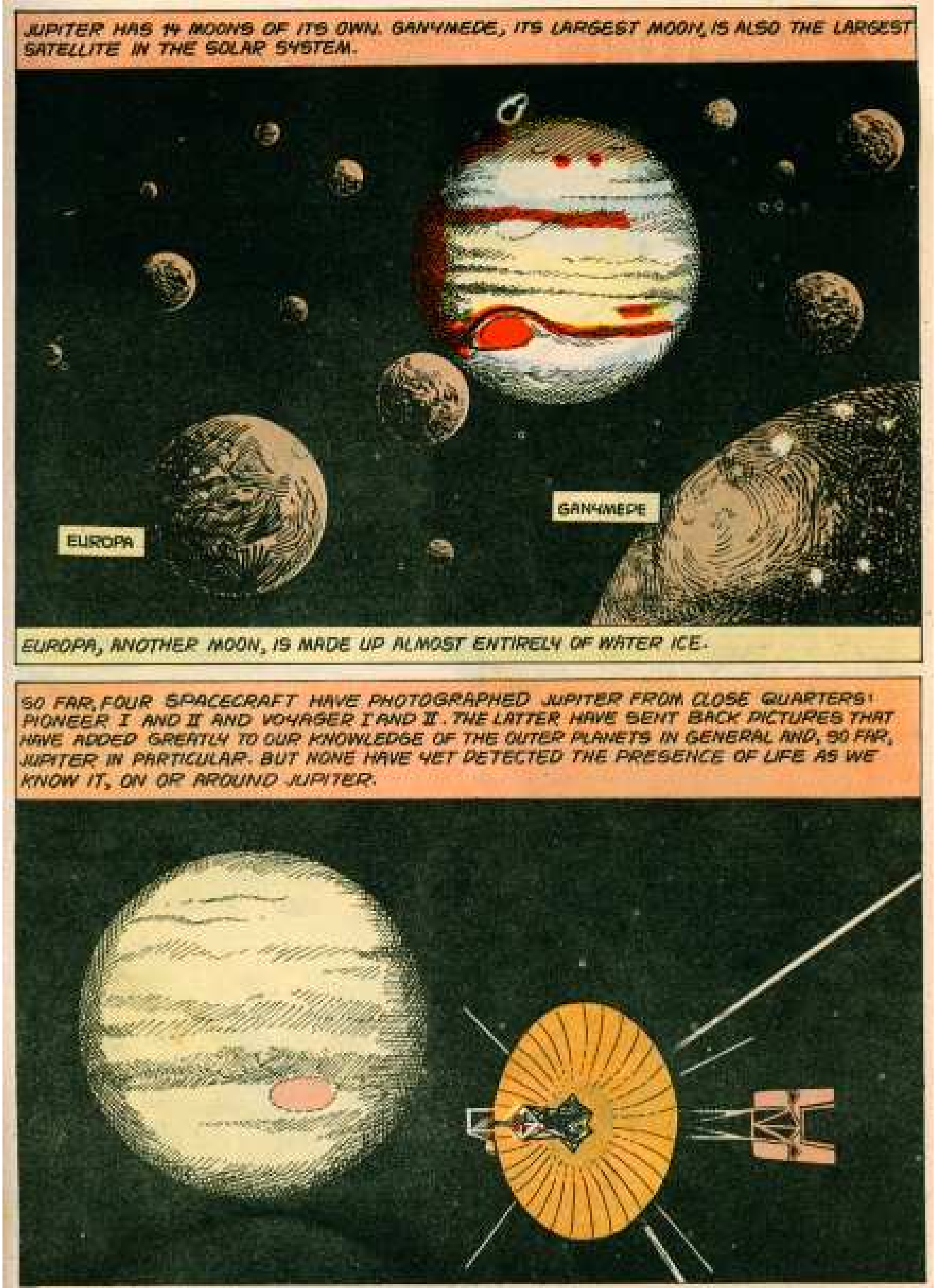

BECAUSE OF ITS FAIRLY HOSPITABLE ENVIRONMENT (COMPARED WITH MERCURY AND VENUS), IT WOULD BE FAR EASIER TO LAND A MANNED SPACECRAFT ON MARS THAN ON ANY OTHER PLANET.
THIS IS A PICTURE OF THE UNMANNED VIKING LANDER, WHICH CONDUCTED TESTS IN 1976 TO FIND OUT WHETHER LIFE EXISTED ON MARS.
VIKING LANDER


ASTEROIDS
Script: J.D. Isloor • Illustrations: Anand Mande
THE LARGE EMPTY SPACE BETWEEN MARS AND JUPITER HAD PUZZLED ASTRONOMERS FOR MANY YEARS. FOR ACCORDING TO THEIR CALCULATIONS, A PLANET OUGHT TO HAVE EXISTED IN THIS REGION.
MERCURY
EARTH
JUPITER
VENUS
MARS
ASTEROID BELT
ON JANUARY 1, 1801 THE ITALIAN ASTRONOMER, GUISEPPE PIAZZI, DISCOVERED A SMALL PLANET IN THAT LARGE GAP. HE OBSERVED IT FOR A FEW DAYS AND THOUGHT IT TO BE THE MISSING PLANET. IT WAS NAMED CERES.
HOWEVER, CERES WAS SO SMALL (LESS THAN 1300 KM. ACROSS), THAT ASTRONOMERS BEGAN TO WONDER IF IT WAS A PLANET AT ALL!
WHEN FURTHER SCRUTINY OF THE SKY IN THAT REGION REVEALED MORE "LITTLE PLANETS", ASTRONOMERS BEGAN CALLING THEM ASTEROIDS, COLLECTIVELY. THEY ARE ALSO CALLED PLANETOIDS.
PALLAS, JUNO AND VESTA (THE BRIGHTEST ASTEROID WHICH, ON CLEAR NIGHTS, CAN BE SEEN WITHOUT A TELESCOPE), WERE DISCOVERED SOON AFTER CERES. EVER SINCE, AT LEAST 40,000 ASTEROIDS HAVE BEEN FOUND ORBITING THE SUN IN THE YAWNING GAP BETWEEN MARS AND JUPITER.


THE ORIGIN OF THE ASTEROIDS IS SHROUDED IN MYSTERY. SOME SCIENTISTS THINK THAT THEY ARE THE REMAINS OF AN ANCIENT PLANET THAT BLEW UP FOR SOME REASON. OTHERS SAY THAT THEY ARE PARTS OF A PLANET WHICH NEVER FORMED.
FEW ASTEROIDS ARE AS BIG AS CERES AND VESTA. MOST OF THEM ARE ONLY A FEW KILOMETRES ACROSS.
THIS IS HOW A MEDIUM-SIZED ASTEROID WOULD LOOK IF IT WERE TO BE BROUGHT ON TO THE EARTH.
BECAUSE OF THEIR SMALL SIZE, THEIR WEAK GRAVITY HAS NOT BEEN ABLE TO PULL THESE BODIES INTO THE SHAPE OF A NEAT BALL. THAT'S WHY THEY'RE NOT SPHERICAL LIKE THE PLANETS.
SCIENTISTS THINK THAT IN THE DISTANT FUTURE, MAN WILL BE ABLE TO USE MATERIAL FROM THE ASTEROIDS TO BUILD HIS SPACE COLONIES!

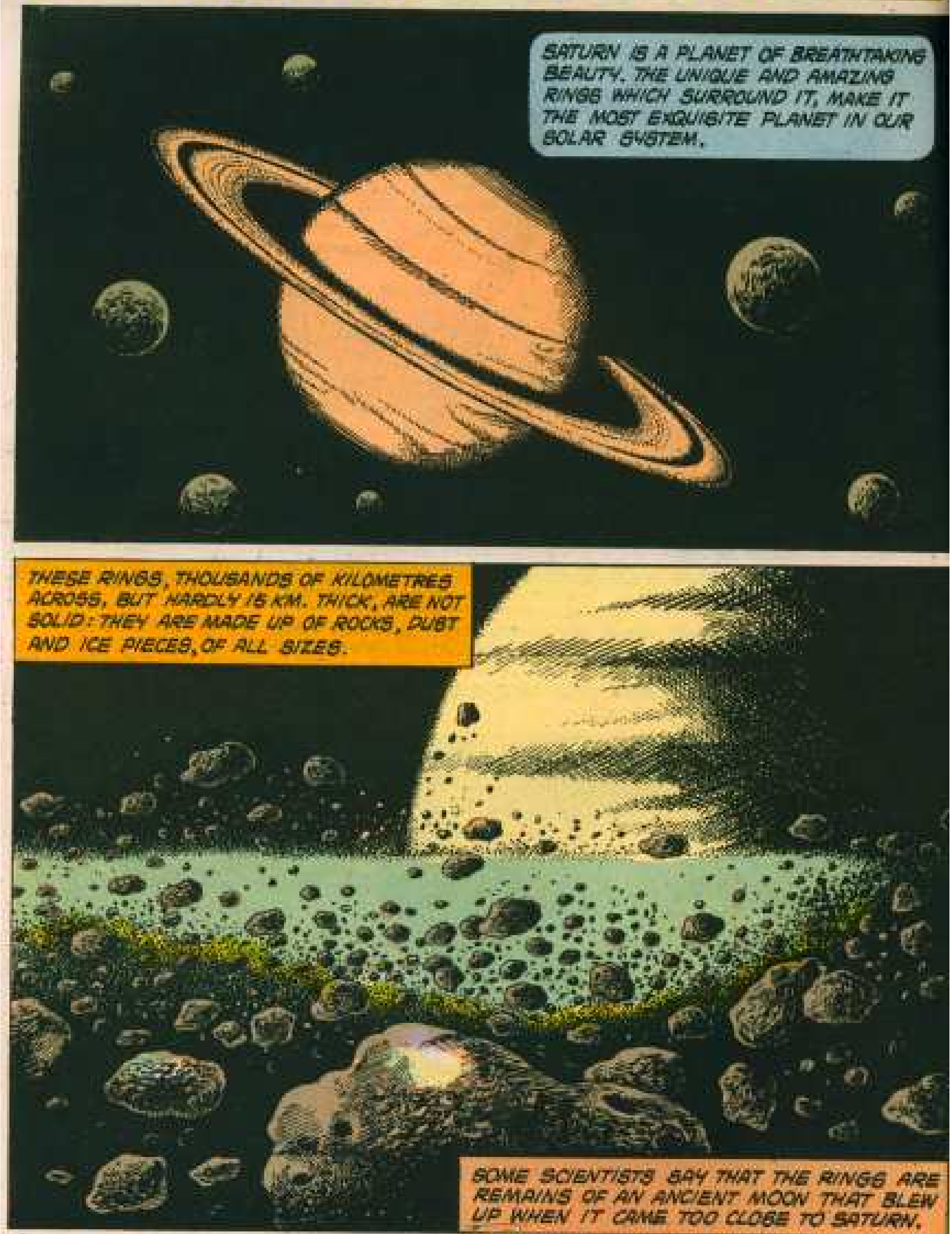

JUPITER
Script:
J.D. Isloor
Illustrations:
Anand Mande
JUPITER IS THE LARGEST PLANET IN THE SOLAR SYSTEM. IT IS SO BIG THAT ITS MASS IS GREATER THAN THAT OF ALL OTHER PLANETS PUT TOGETHER.
JUPITER'S DIAMETER IS 11 TIMES THAT OF THE EARTH AND ITS BULK IS 318 TIMES HEAVIER.
DESPITE ITS GREAT DISTANCE (370 MILLION MILES) FROM THE SUN, IT IS STILL THE SECOND MOST BRILLIANT PLANET IN OUR SKY, AFTER VENUS.
THIS GREAT PLANET HAS APTLY BEEN NAMED AFTER JUPITER, THE KING OF THE GODS OF THE GREEK PANTHEON.
TO HINDUS, IT IS GURU, ASSOCIATED WITH BENEVOLENCE, PLENTY AND WISDOM.


YET, THERE IS ONE ASPECT IN WHICH THE GIGANTIC JUPITER DWARFS ITSELF WHEN COMPARED WITH THE OTHER PLANETS: IT HAS THE SHORTEST DAYS, LASTING ONLY NINE HOURS AND 51 MINUTES.
WHICH MEANS THAT IT ROTATES ON ITS AXIS FASTER THAN ANY OTHER PLANET.
JUPITER'S SURFACE IS BY AND LARGE GASEOUS. AND AS A RESULT OF ITS TREMENDOUS SPEED OF ROTATION, ITS SURFACE FEATURES APPEAR TO BE CHANGING CONTINUOUSLY.
BUT THERE IS ONE MYSTERIOUS FEATURE THAT SEEMS TO BE PERMANENT ON JUPITER'S SPHERE: THE GREAT RED SPOT.
NO ONE KNOWS WHAT IT IS OR WHAT CAUSES IT. IT IS THOUGHT TO BE A PERPETUAL STORM IN A LOCALISED AREA IN THE SOUTHERN HEMISPHERE. THE AREA OF THE SPOT IS LARGER THAN THAT OF THE EARTH!
JUPITER HAS AN ATMOSPHERE MADE UP MAINLY OF HYDROGEN AND HELIUM. OXYGEN HAS NOT YET BEEN DETECTED. THERE ARE SOME SCIENTISTS WHO THINK THAT LIFE MAY EXIST IN THE UPPER ATMOSPHERIC LAYERS OF THIS PLANET OF VIOLENT STORMS AND CHANGING FEATURES.
AN ARTIST'S IMPRESSION OF LIVING BEINGS ON JUPITER.


JUPITER HAS 14 MOONS OF ITS OWN. GANYMEDE, ITS LARGEST MOON, IS ALSO THE LARGEST SATELLITE IN THE SOLAR SYSTEM.
GANYMEDE
EUROPA
EUROPA, ANOTHER MOON, IS MADE UP ALMOST ENTIRELY OF WATER ICE.
SO FAR, FOUR SPACECRAFT HAVE PHOTOGRAPHED JUPITER FROM CLOSE QUARTERS: PIONEER I AND II AND VOYAGER I AND II. THE LATTER HAVE SENT BACK PICTURES THAT HAVE ADDED GREATLY TO OUR KNOWLEDGE OF THE OUTER PLANETS IN GENERAL AND, SO FAR, JUPITER IN PARTICULAR. BUT NONE HAVE YET DETECTED THE PRESENCE OF LIFE AS WE KNOW IT, ON OR AROUND JUPITER.

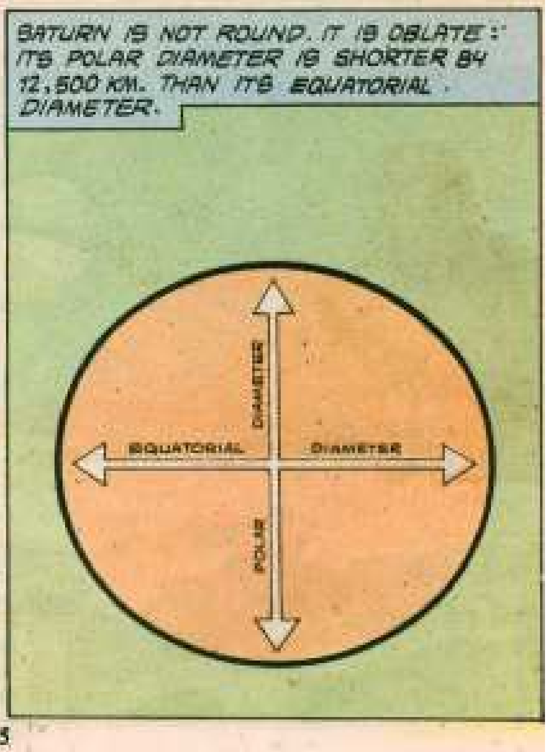
SATURN

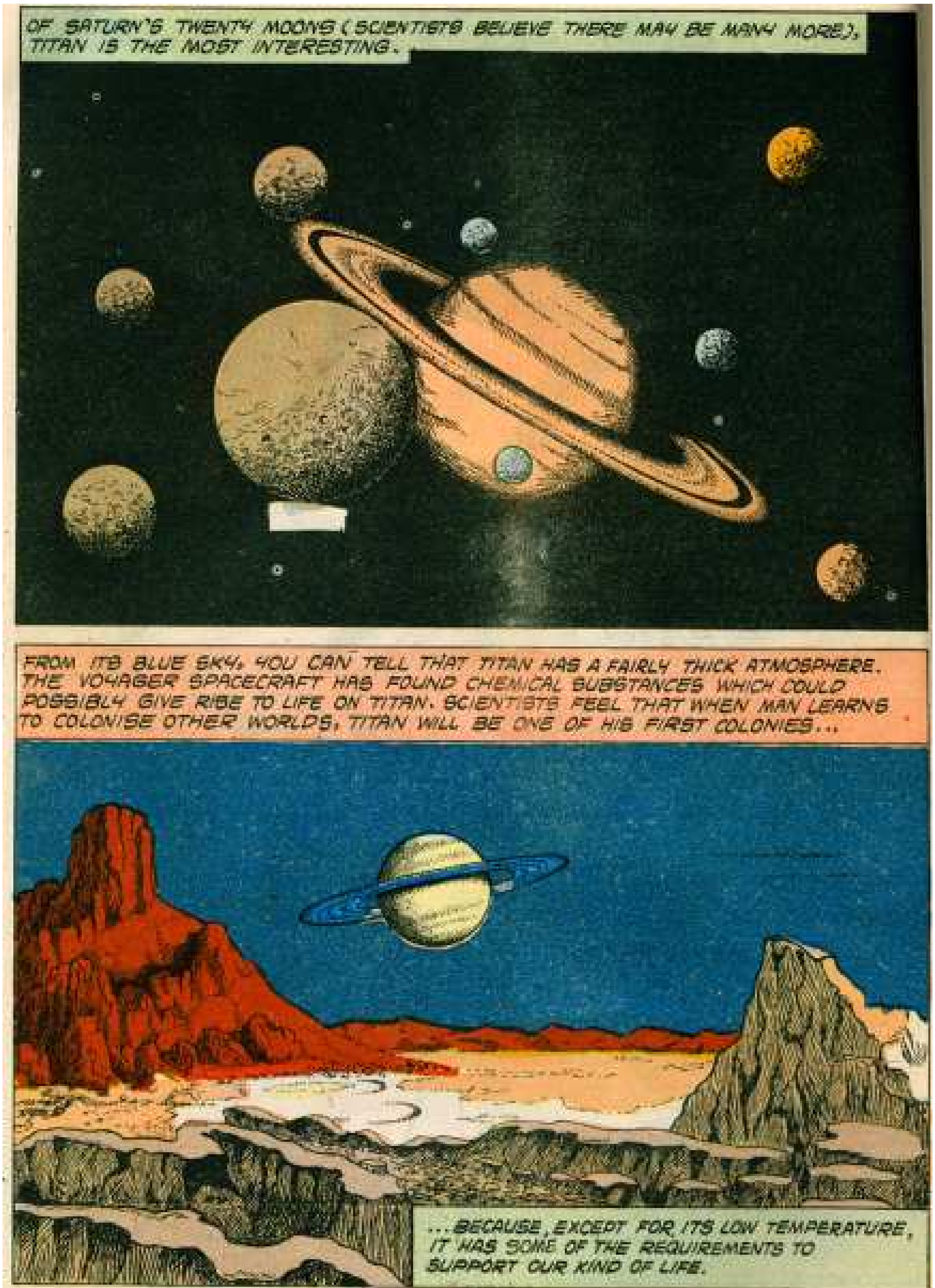
Script: J.D Isloor
Illustrations: Anand Mande




UNLIKE JUPITER, WHICH HAS FASCINATING SURFACE FEATURES, SATURN IS A REMARKABLY FEATURELESS PLANET. EXCEPT FOR A FEW BANDS, YOU CANNOT SEE TOO MANY SURFACE DETAILS.
SATURN IS A PLANET OF VIOLENT STORMS. WINDS BLOW AT THE INCREDIBLE SPEED OF 1700 KM. PER HOUR.

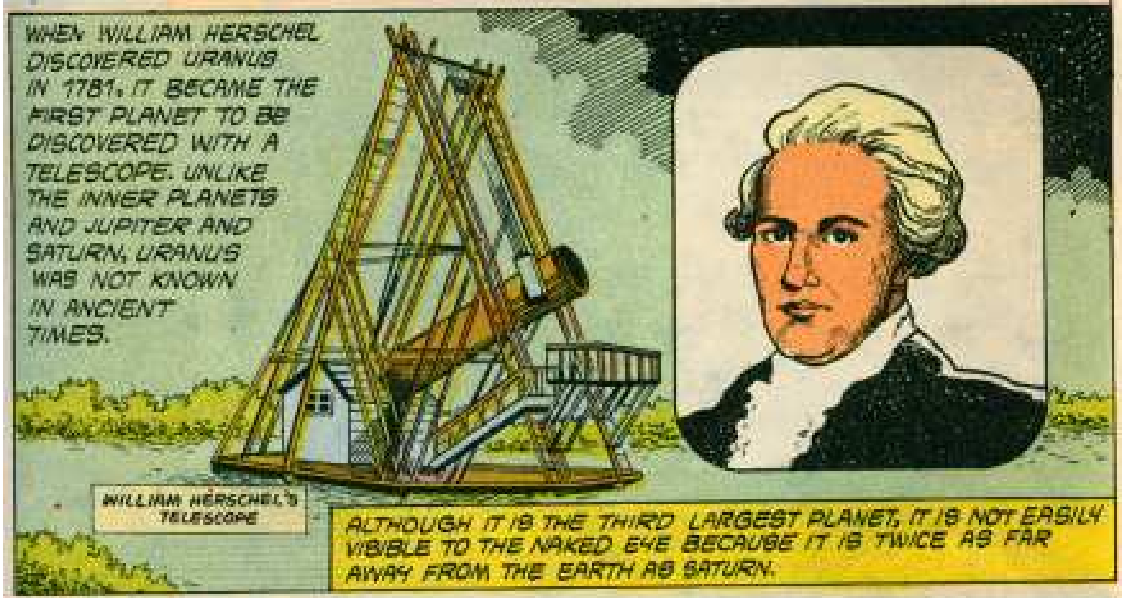

THOUGH IT IS 95 TIMES HEAVIER THAN THE EARTH, SATURN'S DENSITY IS SO LOW THAT IT WOULD EASILY FLOAT IN AN OCEAN OF WATER!


SATURN IS NOT ROUND. IT IS OBLATE: ITS POLAR DIAMETER IS SHORTER BY 12,500 KM. THAN ITS EQUATORIAL DIAMETER.
DIAMETER
EQUATORIAL
DIAMETER
POLAR

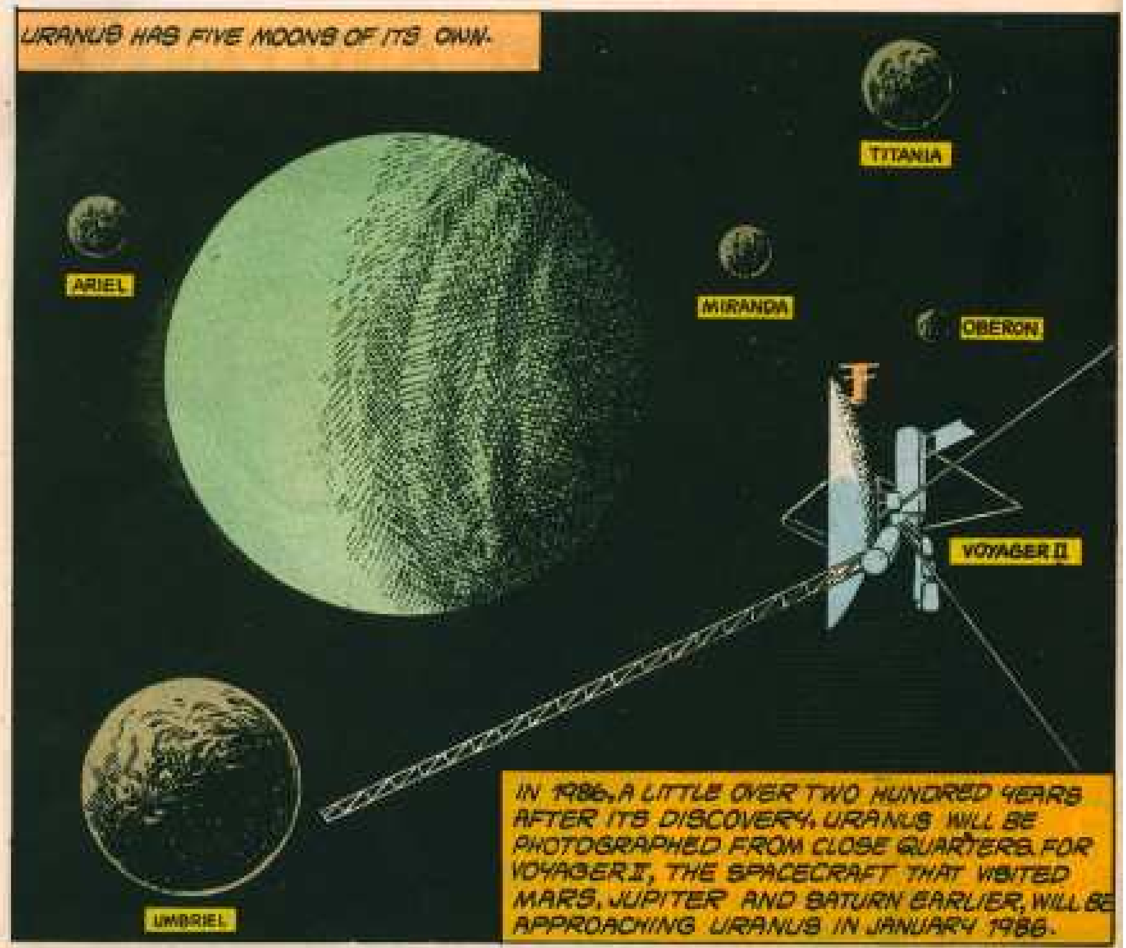

OF SATURN'S TWENTY MOONS (SCIENTISTS BELIEVE THERE MAY BE MANY MORE), TITAN IS THE MOST INTERESTING.
FROM ITS BLUE SKY, YOU CAN TELL THAT TITAN HAS A FAIRLY THICK ATMOSPHERE. THE VOYAGER SPACECRAFT HAS FOUND CHEMICAL SUBSTANCES WHICH COULD POSSIBLY GIVE RISE TO LIFE ON TITAN. SCIENTISTS FEEL THAT WHEN MAN LEARNS TO COLONISE OTHER WORLDS, TITAN WILL BE ONE OF HIS FIRST COLONIES...
...BECAUSE, EXCEPT FOR ITS LOW TEMPERATURE, IT HAS SOME OF THE REQUIREMENTS TO SUPPORT OUR KIND OF LIFE.

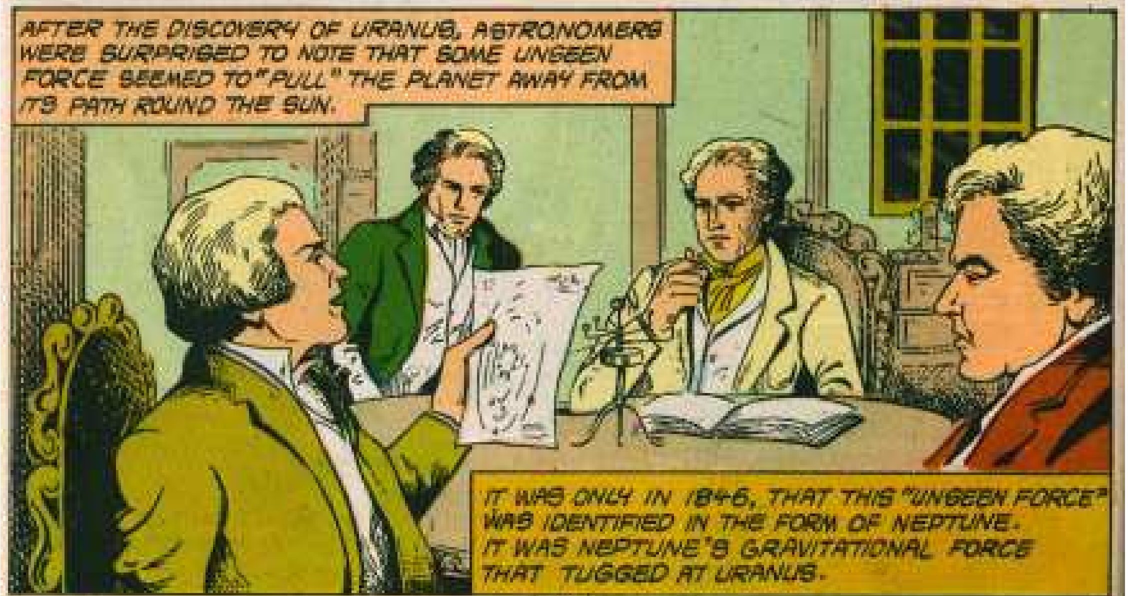
URANUS, NEPTUNE AND PLUTO

Script : J.D. Isloor & Dev Nadkarni   Illustrations : Anand Mande






URANUS HAS FIVE MOONS OF ITS OWN.
TITANIA
ARIEL
MIRANDA
OBERON
VOYAGER II
UMBRIEL
IN 1986, A LITTLE OVER TWO HUNDRED YEARS AFTER ITS DISCOVERY, URANUS WILL BE PHOTOGRAPHED FROM CLOSE QUARTERS. FOR VOYAGER II, THE SPACECRAFT THAT VISITED MARS, JUPITER AND SATURN EARLIER, WILL BE APPROACHING URANUS IN JANUARY 1986.

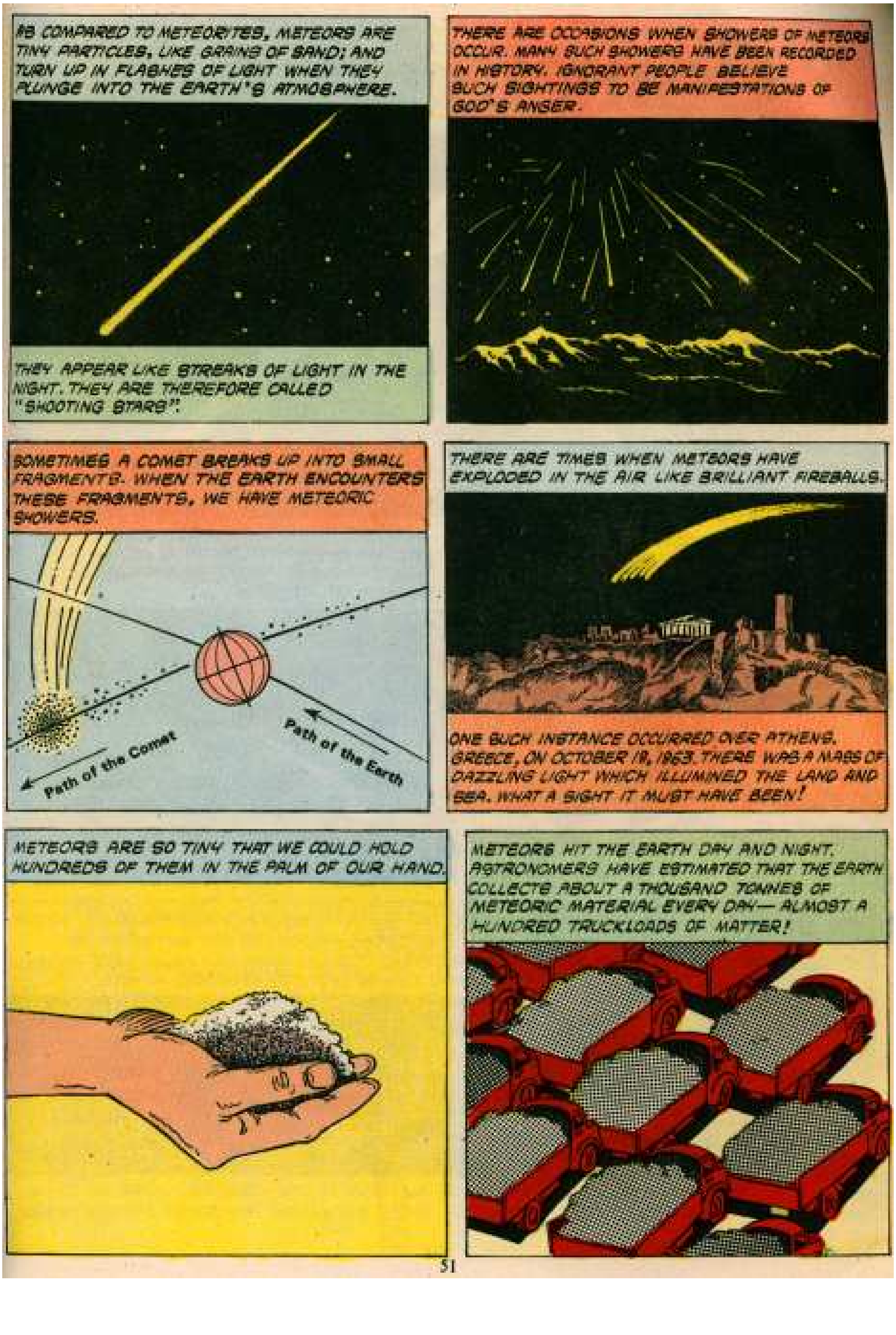

AFTER THE DISCOVERY OF URANUS, ASTRONOMERS WERE SURPRISED TO NOTE THAT SOME UNSEEN FORCE SEEMED TO "PULL" THE PLANET AWAY FROM ITS PATH ROUND THE SUN.
IT WAS ONLY IN 1846, THAT THIS "UNSEEN FORCE" WAS IDENTIFIED IN THE FORM OF NEPTUNE. IT WAS NEPTUNE'S GRAVITATIONAL FORCE THAT TUGGED AT URANUS.


NEPTUNE IS ONLY SLIGHTLY SMALLER THAN URANUS AND IN SEVERAL WAYS APPEARS TO BE SIMILAR TO IT. INDEED, THAT'S WHY THE TWO ARE REFERRED TO AS THE "TWINS" OF OUR SOLAR SYSTEM.
NEREID
NEPTUNE AS IT WOULD APPEAR FROM ITS MOON, TRITON: ITS OTHER MOON IS NEREID.
NEPTUNE IS ALSO LARGELY MADE UP OF GAS. IT HAS TWO MOONS OF ITS OWN. NEPTUNE TAKES 165 EARTH-YEARS TO MAKE ONE REVOLUTION ROUND THE SUN. THEREFORE, IT WILL NOT BE BACK IN THE POSITION WHERE IT WAS DISCOVERED (IN 1846) UNTIL THE YEAR 2011. VOYAGER II WILL REACH NEPTUNE IN AUGUST 1989.
PLUTO IS THE FARTHEST KNOWN PLANET IN OUR SOLAR SYSTEM AND WAS DISCOVERED ONLY IN 1930. VERY LITTLE IS KNOWN ABOUT THIS ICY WORLD. ITS ONE YEAR EQUALS 248 OF OUR YEARS. UNLIKE THE OUTER GIANTS—JUPITER, SATURN, URANUS AND NEPTUNE—PLUTO IS A DWARF, NOT MUCH BIGGER THAN MERCURY.
AFTER ITS MEETING WITH NEPTUNE, VOYAGER II WILL LEAVE THE SOLAR SYSTEM WITHOUT MEETING PLUTO. SO IT WILL BE QUITE A FEW DECADES BEFORE WE KNOW MORE ABOUT THIS REMOTE LITTLE MEMBER OF OUR SUN'S FAMILY.

Meteors and Meteorites

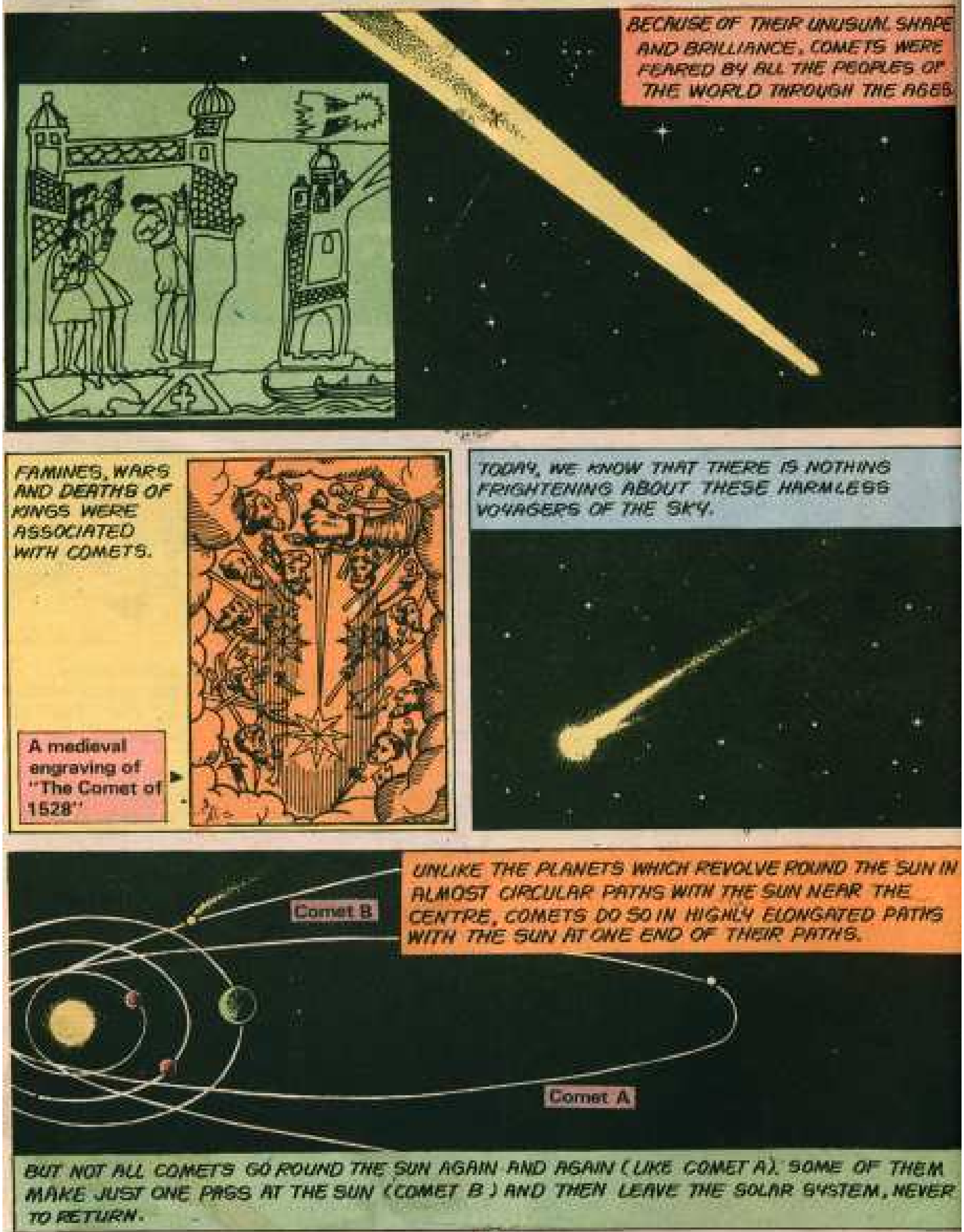
Script: J.D. Isloor
Illustrations: Anand Mande




AS COMPARED TO METEORITES, METEORS ARE TINY PARTICLES, LIKE GRAINS OF SAND; AND TURN UP IN FLASHES OF LIGHT WHEN THEY PLUNGE INTO THE EARTH'S ATMOSPHERE.
THEY APPEAR LIKE STREAKS OF LIGHT IN THE NIGHT. THEY ARE THEREFORE CALLED "SHOOTING STARS".
THERE ARE OCCASIONS WHEN SHOWERS OF METEORS OCCUR. MANY SUCH SHOWERS HAVE BEEN RECORDED IN HISTORY. IGNORANT PEOPLE BELIEVE SUCH SIGHTINGS TO BE MANIFESTATIONS OF GOD'S ANGER.
SOMETIMES A COMET BREAKS UP INTO SMALL FRAGMENTS. WHEN THE EARTH ENCOUNTERS THESE FRAGMENTS, WE HAVE METEORIC SHOWERS.
Path of the Comet
Path of the Earth
THERE ARE TIMES WHEN METEORS HAVE EXPLODED IN THE AIR LIKE BRILLIANT FIREBALLS.
ONE SUCH INSTANCE OCCURRED OVER ATHENS, GREECE, ON OCTOBER 19, 1963. THERE WAS A MASS OF DAZZLING LIGHT WHICH ILLUMINED THE LAND AND SEA. WHAT A SIGHT IT MUST HAVE BEEN!
METEORS ARE SO TINY THAT WE COULD HOLD HUNDREDS OF THEM IN THE PALM OF OUR HAND.
METEORS HIT THE EARTH DAY AND NIGHT. ASTRONOMERS HAVE ESTIMATED THAT THE EARTH COLLECTS ABOUT A THOUSAND TONNES OF METEORIC MATERIAL EVERY DAY— ALMOST A HUNDRED TRUCKLOADS OF MATTER!

Comets

Script: J.D. Isloor
Illustrations: Anand Mande

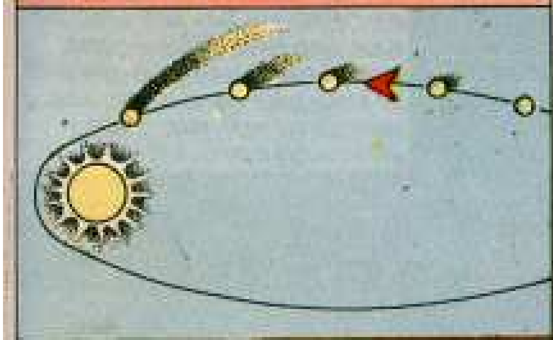


WHEN SEEN THROUGH A TELESCOPE, A COMET APPEARS TO HAVE A NUCLEUS AND A LONG TAIL. THE NUCLEUS IS MADE OF ROCKS AND ICE SURROUNDED BY A CLOUD OF GASEOUS MATTER CALLED "COMA". THE TAIL CONSISTS OF GAS AND DUST.



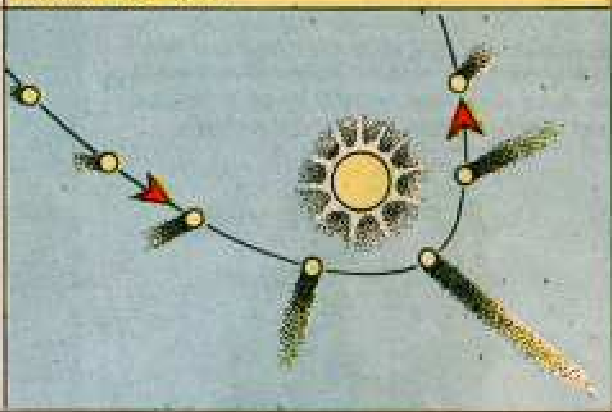
A COMET, ALONG WITH ITS TAIL, OCCUPIES A LARGE VOLUME OF SPACE—SOMETIMES EVEN LARGER THAN THAT OCCUPIED BY THE EARTH. YET IT HAS VERY LITTLE MATTER IN IT. COMETS HAVE RIGHTLY BEEN CALLED "GREAT BIG BAGS, FULL OF NOTHING".

WHEN THEY ARE FAR AWAY FROM THE SUN, COMETS HAVE NO TAILS.



IT IS ONLY AS THEY COME CLOSER TO THE SUN THAT THEY BEGIN TO GROW TAILS.

COMETS ALWAYS HAVE THEIR TAILS AWAY FROM THE SUN.



Here are some well-known Comets, the intervals at which they come to greet the sun and the years in which they were first recorded:

Halley's: Once in 76 years.
First recorded in 240 B.C.



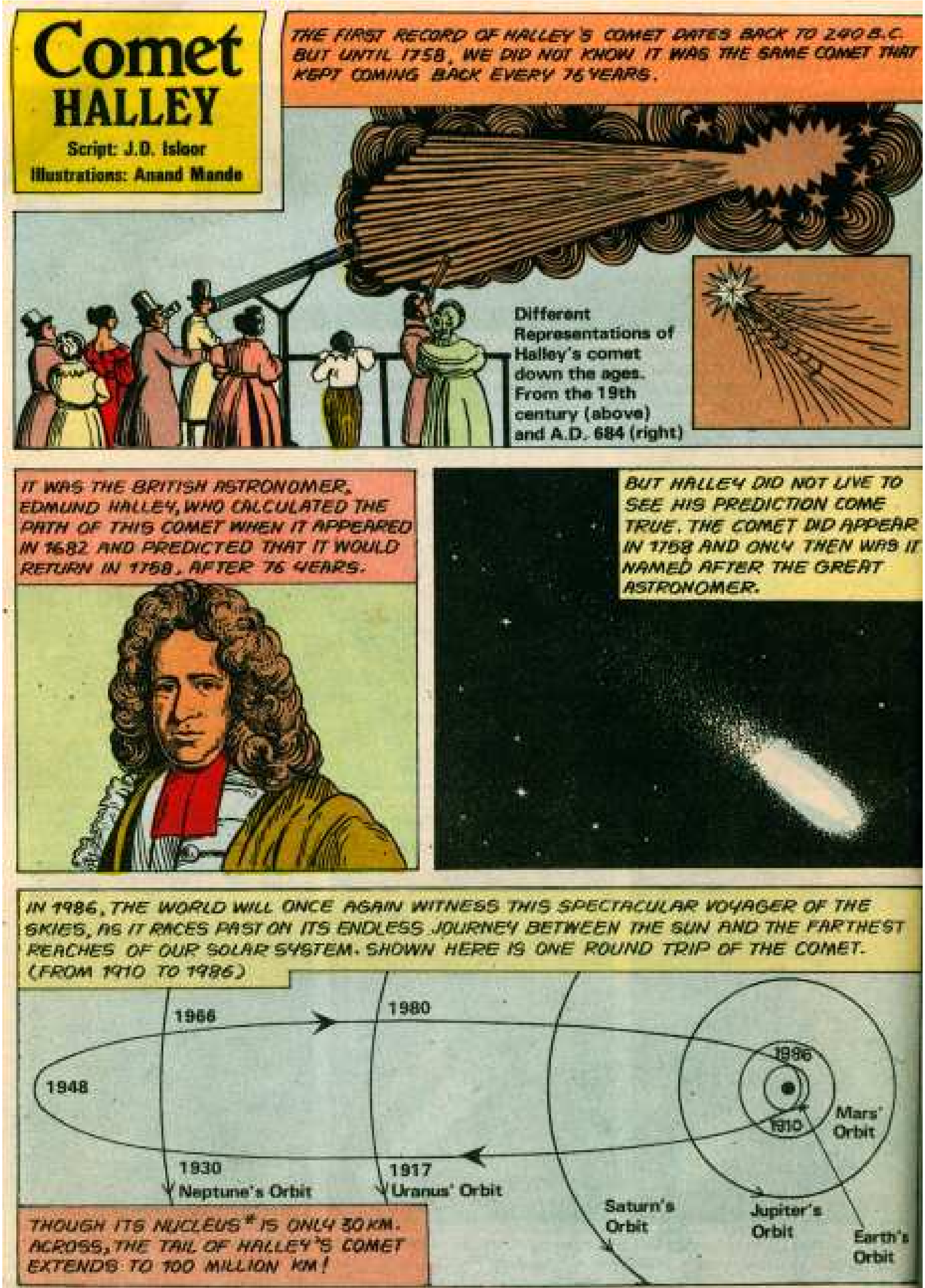
Kohoutek: Period not known.
First recorded in 1975.



Donati's: Once in 2040 years.
First recorded in 1958.



Encke's Comet, first recorded in 1786, returns every 3.3 years and Arend-Roland Comet, which was recorded for the first time in 1957, will return only 10,000 years later—in 11,957 A.D.!



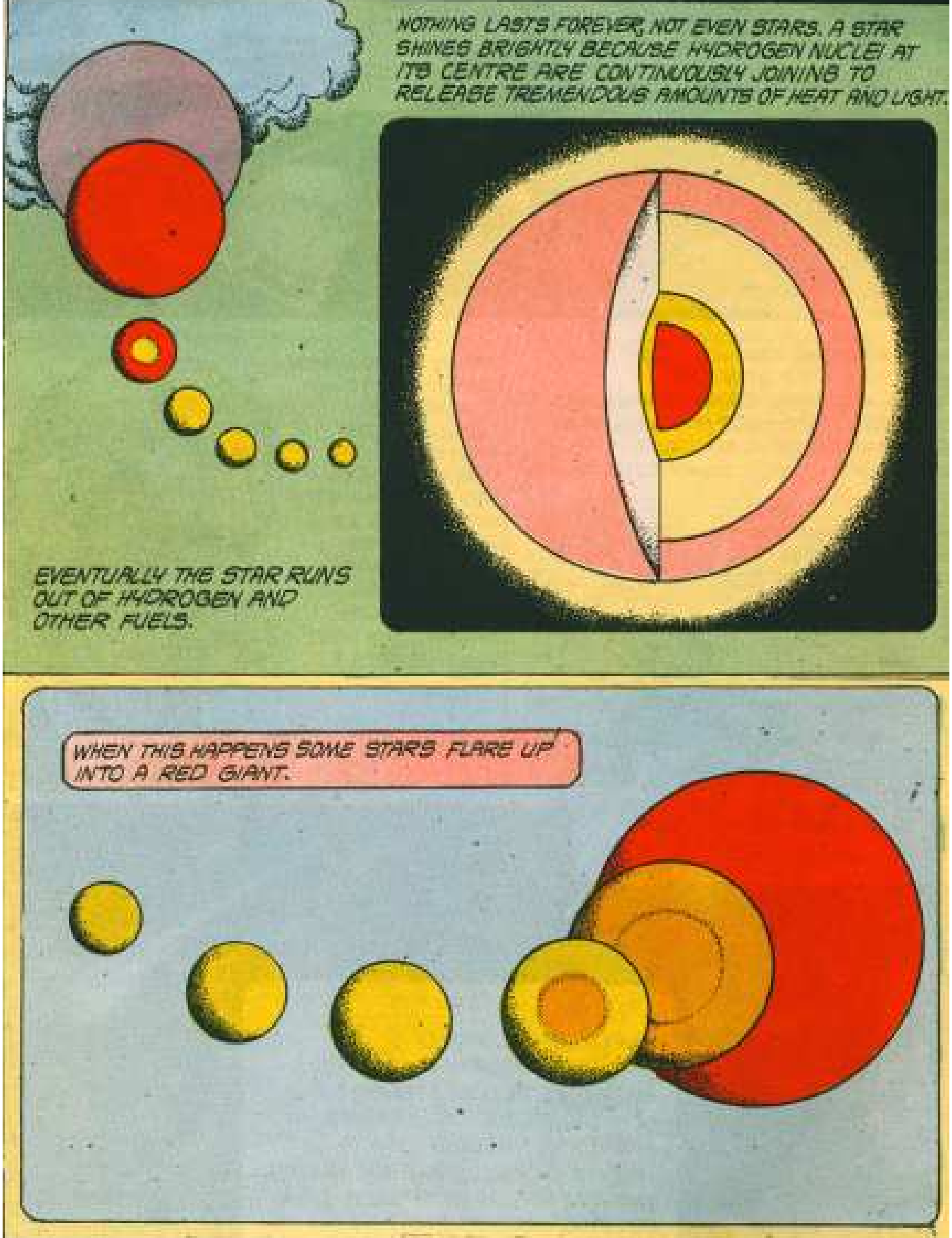
* SEE TINKLE NO. 91



ON ITS PRESENT VISIT, HALLEY'S COMET WILL BE CLOSELY PROBED BY A NUMBER OF MACHINES, TELESCOPES AND EVEN SPACE CRAFT. ONE UNMANNED, EUROPEAN SPACECRAFT, CALLED "GIOTTO" WILL TRY AND PHOTOGRAPH THE COMET FROM WITHIN 1000KM. OF ITS PATH!
GIOTTO
AN ARTIST'S IMPRESSION OF AN ENCOUNTER WITH HALLEY'S COMET
WARS, DISASTERS, AND ILL-LUCK HAVE BEEN ASSOCIATED WITH THE APPEARANCE OF ALL COMETS. HALLEY'S WAS NO EXCEPTION. BUT IT IS NEEDLESS TO SAY THAT THERE IS NO TRUTH WHATSOEVER IN THESE SUPERSTITIONS.
Woodcut showing Halley's comet in August 1531
THERE IS, HOWEVER, ONE INTERESTING COINCIDENCE INVOLVING THE HALLEY'S COMET. THE WELL-KNOWN AMERICAN WRITER MARK TWAIN WAS BORN DURING THE APPEARANCE OF THE COMET IN 1835 AND DIED DURING ITS NEXT VISIT IN 1910!
HERE ARE SOME INTERESTING FEATURES ABOUT HALLEY'S COMET.
EARLIEST RECORDED OBSERVATION : 240 B.C.
MASS: 19 BILLION TONNES
ORBITAL PERIOD: 76·1 YEARS.
RADIUS OF NUCLEUS : 15 KM.
LENGTH OF TAIL : ABOUT 100 MILL. KM.
CLOSEST TO EARTH: APRIL 11. 1986 (DURING CURRENT TRIP)

BLACK HOLES

Script : J.D. Isloor
Illustrations : Anand Mande




THE RED GIANT IS UNSTABLE. IT PUFFS OFF ITS OUTER LAYERS AND THESE DRIFT OFF INTO SPACE LOOKING LIKE HUGE SMOKE RINGS. SUCH A RING IS CALLED A NEBULA.
FINALLY, ALL THAT IS LEFT IS A VERY DENSE WHITE DWARF STAR. THIS SLOWLY COOLS DOWN UNTIL IT IS ONLY A COLD DARK CINDER IN SPACE.
IN THE CASE OF SOME GIANT STARS, A VIOLENT EXPLOSION MAY TAKE PLACE.
THE CORE WILL START COLLAPSING TO FORM A VERY VERY DENSE BODY. THIS SUPER DENSE GLOBE IS CALLED A NEUTRON STAR.
EVEN A SPOONFUL OF MATTER FROM A NEUTRON STAR WOULD WEIGH MILLIONS OF TONNES.
THE NEUTRON STAR SPINS VERY RAPIDLY AND GIVES OFF BURSTS OF RADIATION.

ARTIST'S IMPRESSION OF A BLACK HOLE.
A BLACK HOLE CANNOT BE SEEN.



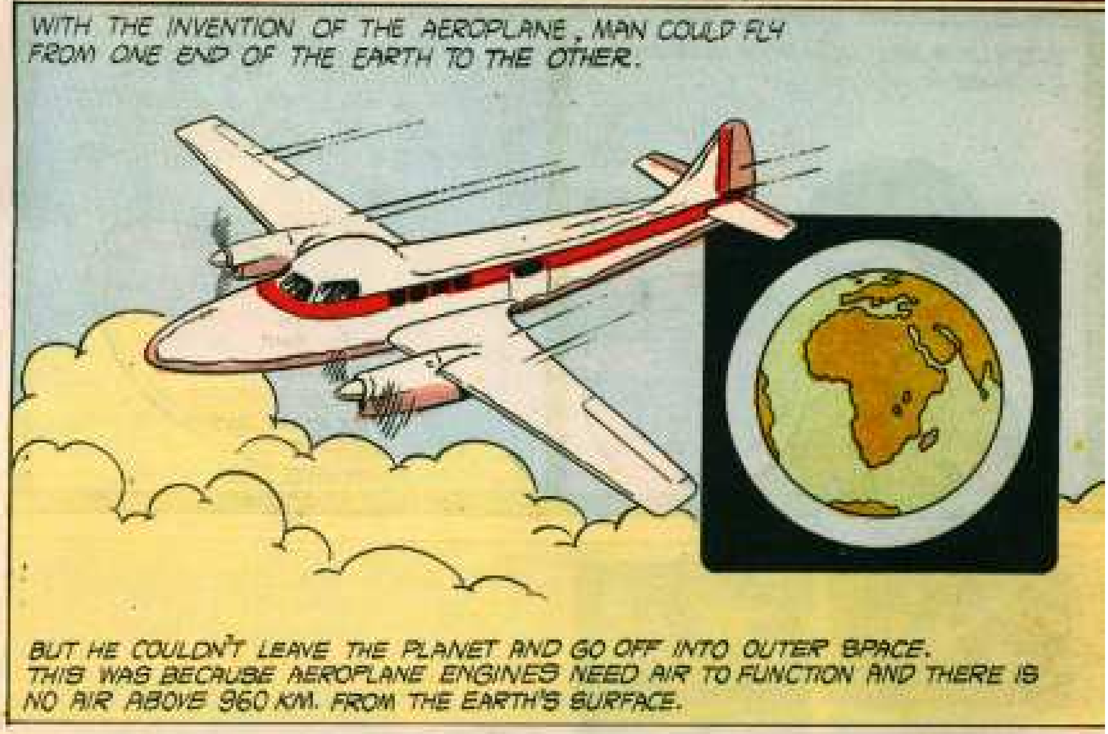
SOME STARS SHRINK EVEN FURTHER AND END UP AS BLACK HOLES.
IN A BLACK HOLE A HUGE AMOUNT OF MATTER IS HEAVILY COMPRESSED INTO A VERY SMALL SPACE.
THE BLACK HOLE HAS SUCH A TREMENDOUS GRAVITATIONAL PULL THAT IT SUCKS IN ANYTHING THAT GOES NEAR IT...
AND ANYTHING THAT GOES INSIDE A BLACK HOLE NEVER COMES OUT AGAIN. IT IS LOST FOREVER.
A BLACK HOLE DOESN'T EVEN LET LIGHT COME OUT OF IT. SO WE CANNOT SEE A BLACK HOLE.
IT IS TOTALLY INVISIBLE.

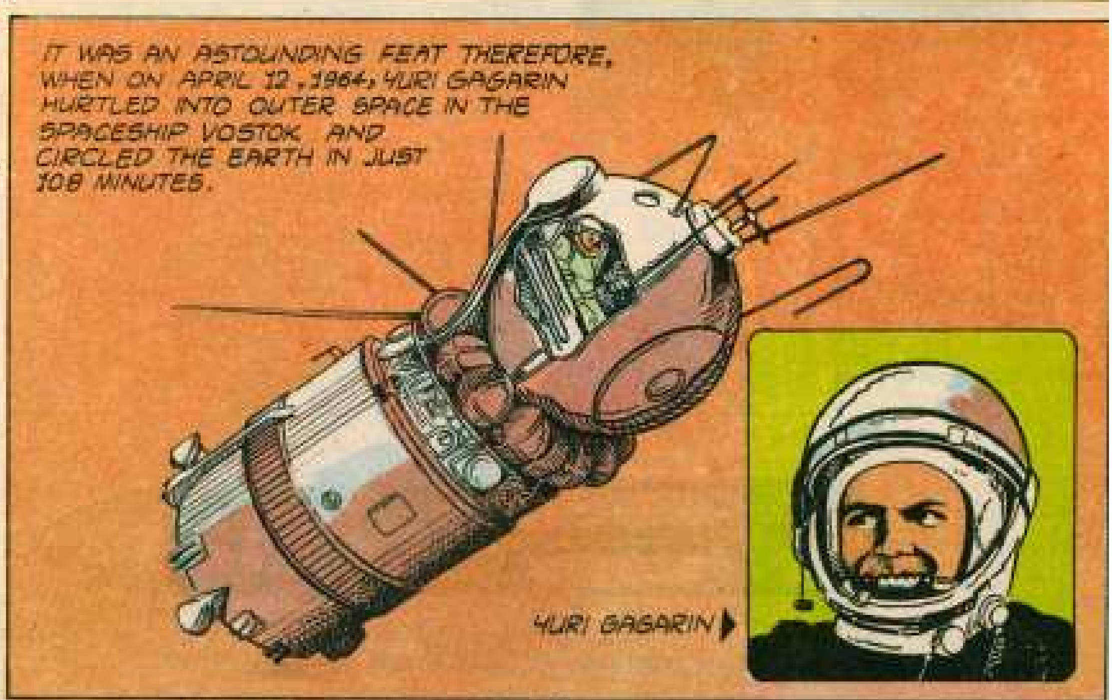
TODAY SOME SCIENTISTS BELIEVE THAT THERE MAY BE HUGE BLACK HOLES AT THE CENTRE OF MOST GALAXIES, INCLUDING OUR OWN MILKY WAY, DEVOURING ENTIRE STARS AT A GULP.



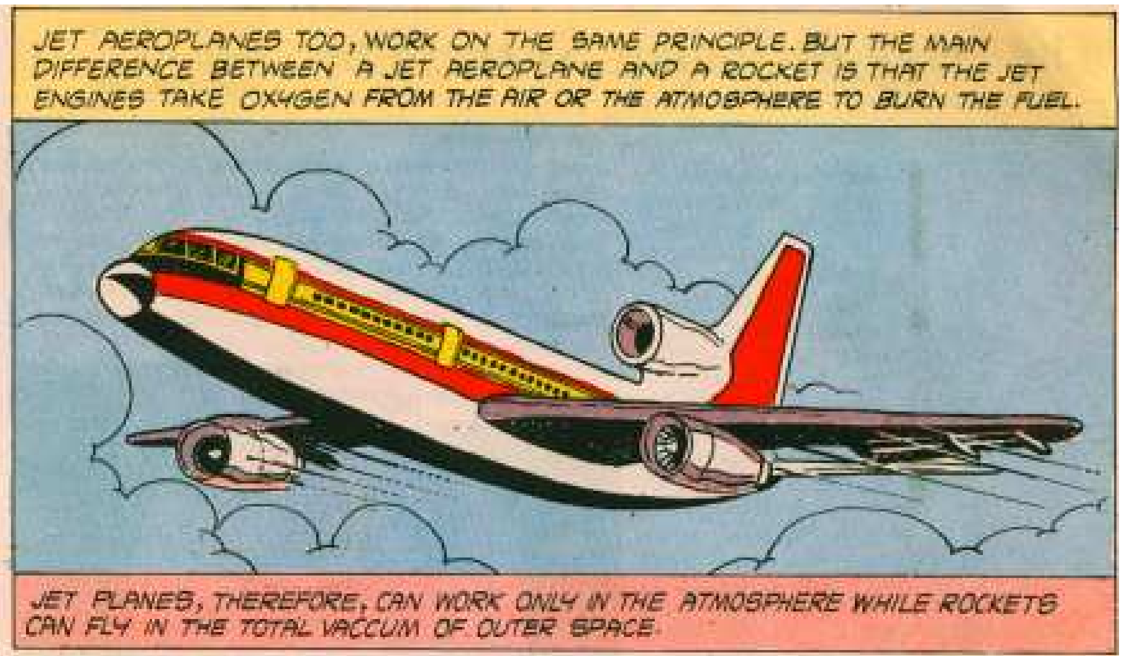
The Saga of Spaceships

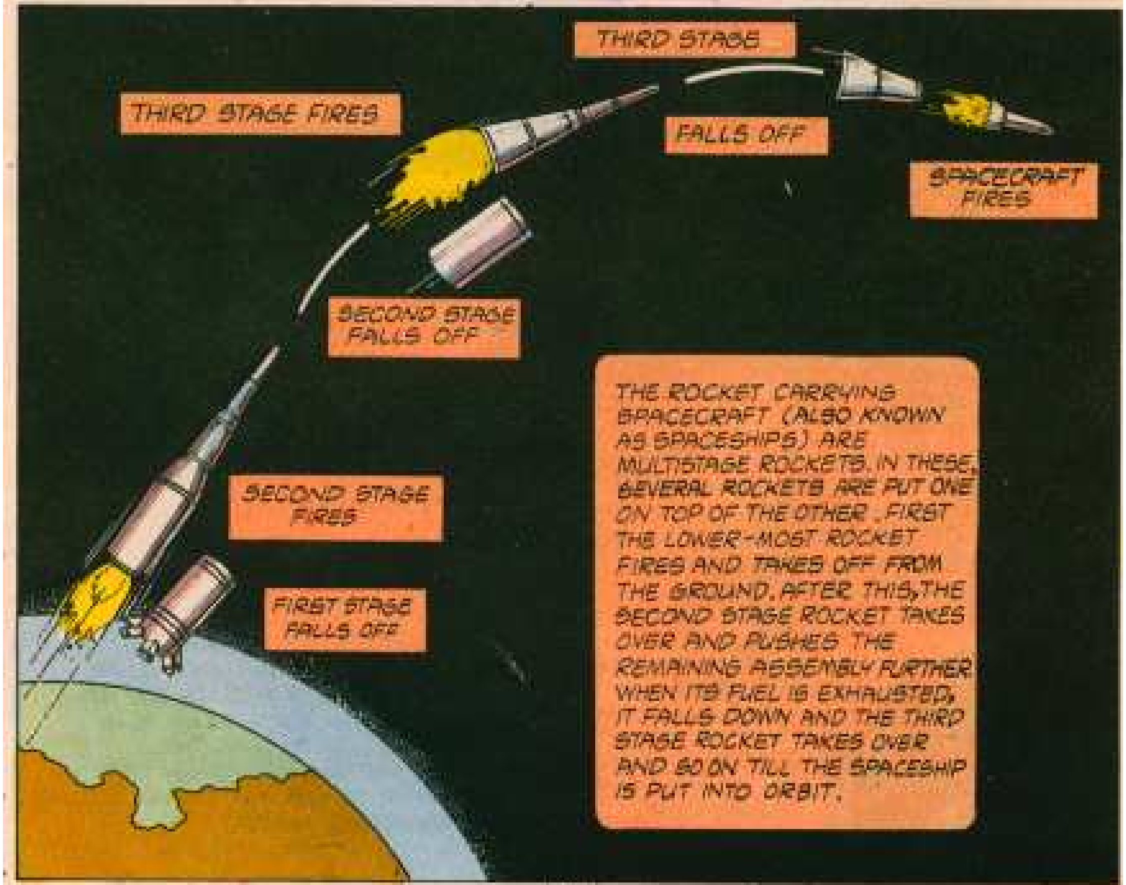
Script : J.D. Isloor
Illustrations : Anand Mande






WE NEED POWERFUL ROCKETS TO LAUNCH SPACESHIPS INTO SPACE. THE BASIC PRINCIPLE OF THE WORKING OF A ROCKET IS VERY SIMPLE. IT CAN EASILY BE ILLUSTRATED WITH THE HELP OF A BALLOON.
BLOW UP A BALLOON AND SUDDENLY RELEASE IT...
...IT FLIES AWAY AS IT REDUCES TO ITS ORIGINAL SIZE. AS THE AIR FROM THE BALLOON GUSHES OUT FROM THE NOZZLE, THE REACTION PUSHES THE BALLOON FORWARD.
A Three-Stage Rocket
IN ROCKETS, FUEL IS BURNT IN THE BURNING (COMBUSTION) CHAMBER. THE OXYGEN REQUIRED FOR THIS BURNING IS STORED IN TANKS WITHIN THE ROCKETS THEMSELVES. ROCKETS THEREFORE, DO NOT DEPEND UPON THE ATMOSPHERE FOR OXYGEN.
THE HOT GASES THAT ARE PRODUCED AS A RESULT OF COMBUSTION EXPAND AND GUSH OUT THROUGH THE NOZZLE, PUSHING THE ROCKET FORWARD.
Combustion Chamber
Fuel Tank
Liquid Oxygen Tank
Payload


JET AEROPLANES TOO, WORK ON THE SAME PRINCIPLE. BUT THE MAIN DIFFERENCE BETWEEN A JET AEROPLANE AND A ROCKET IS THAT THE JET ENGINES TAKE OXYGEN FROM THE AIR OR THE ATMOSPHERE TO BURN THE FUEL.
JET PLANES, THEREFORE, CAN WORK ONLY IN THE ATMOSPHERE WHILE ROCKETS CAN FLY IN THE TOTAL VACCUM OF OUTER SPACE.

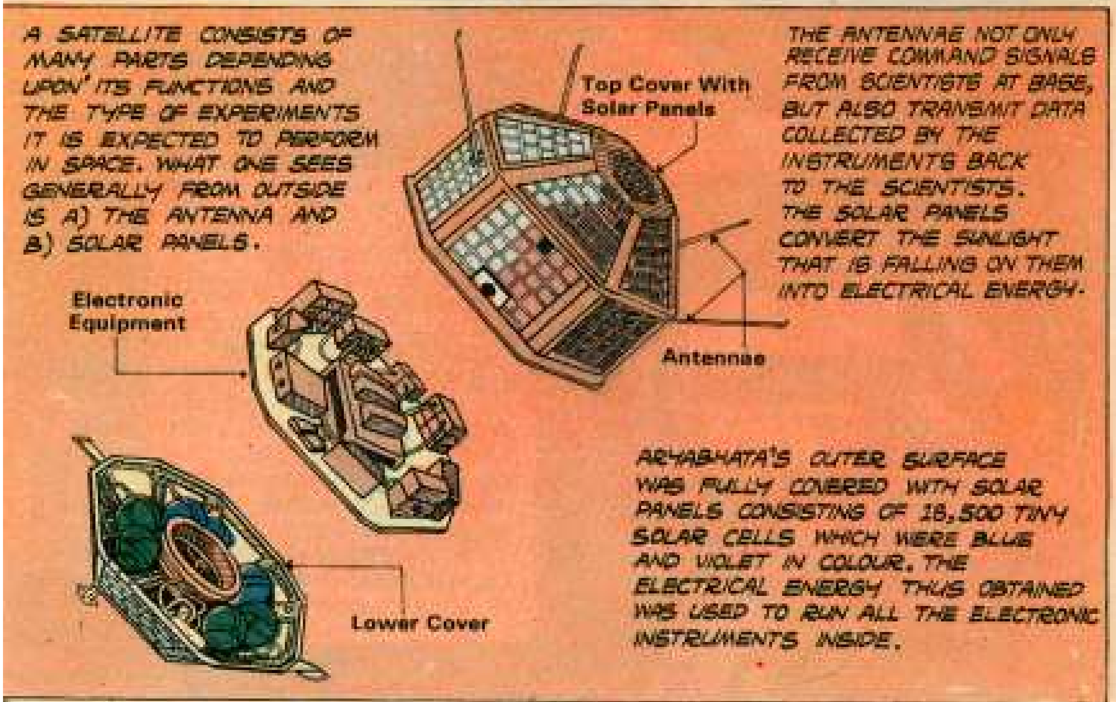

THIRD STAGE
FALLS OFF
THIRD STAGE FIRES
SPACECRAFT FIRES
SECOND STAGE FALLS OFF
SECOND STAGE FIRES
FIRST STAGE FALLS OFF
THE ROCKET CARRYING SPACECRAFT (ALSO KNOWN AS SPACESHIPS) ARE MULTISTAGE ROCKETS. IN THESE, SEVERAL ROCKETS ARE PUT ONE ON TOP OF THE OTHER. FIRST THE LOWER-MOST ROCKET FIRES AND TAKES OFF FROM THE GROUND. AFTER THIS, THE SECOND STAGE ROCKET TAKES OVER AND PUSHES THE REMAINING ASSEMBLY FURTHER. WHEN ITS FUEL IS EXHAUSTED, IT FALLS DOWN AND THE THIRD STAGE ROCKET TAKES OVER AND SO ON TILL THE SPACESHIP IS PUT INTO ORBIT.

The Saga of Indian Spaceships

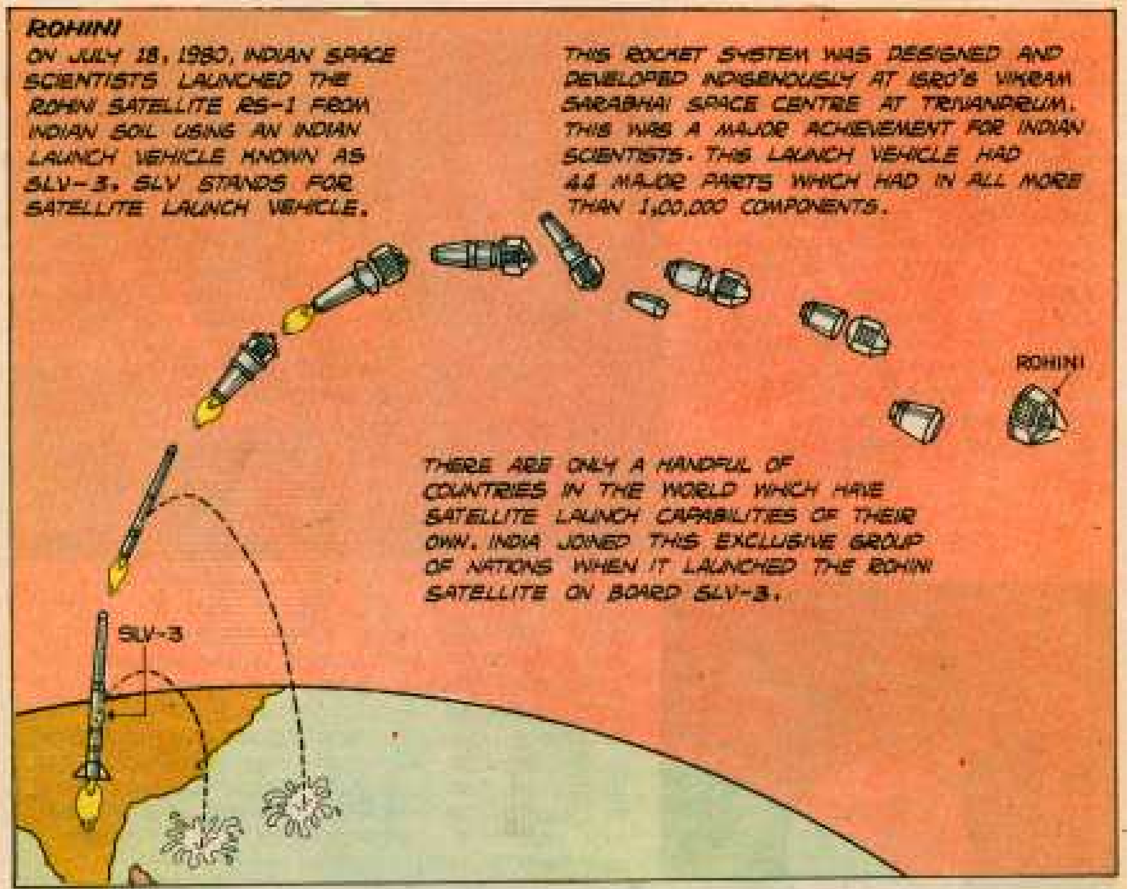
Script: J.D. Isloor
Illustrations: Anand Mande

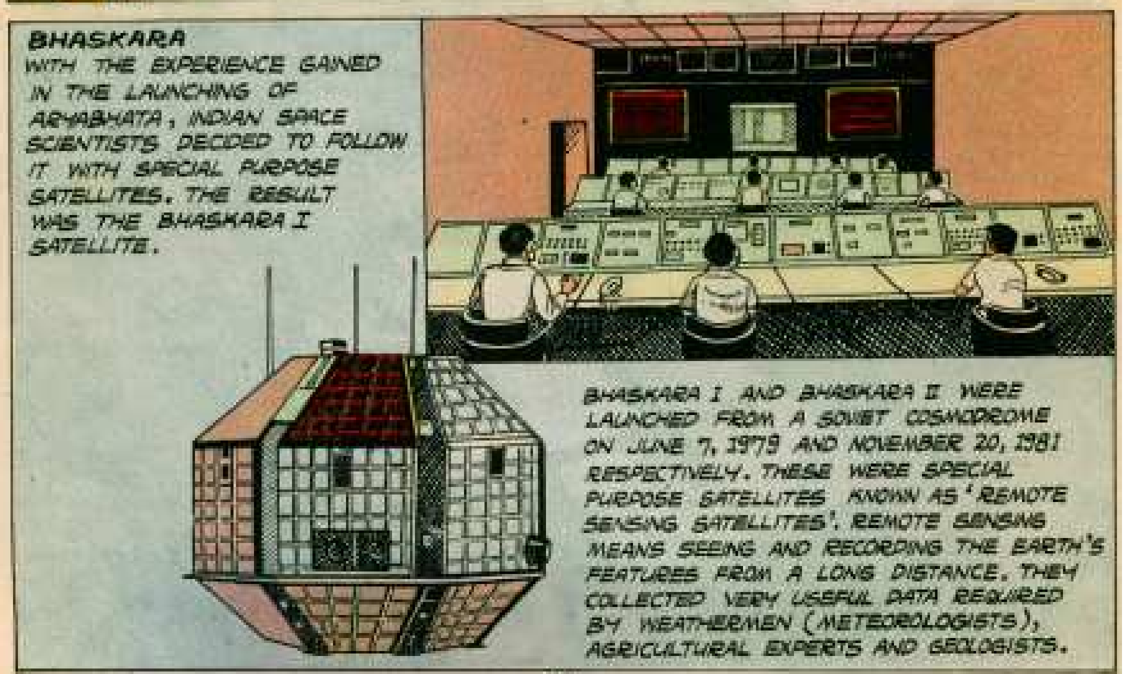






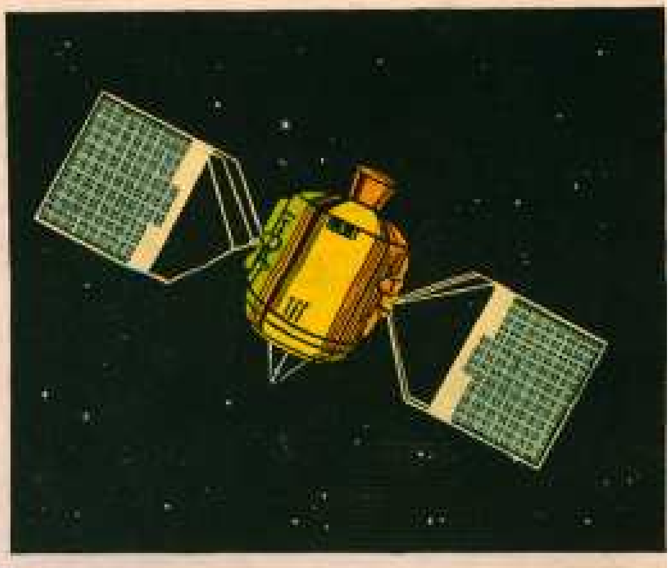
* INDIAN SPACE RESEARCH ORGANISATION


ROHINI
ON JULY 18, 1980, INDIAN SPACE SCIENTISTS LAUNCHED THE ROHINI SATELLITE RS-1 FROM INDIAN SOIL USING AN INDIAN LAUNCH VEHICLE KNOWN AS SLV-3. SLV STANDS FOR SATELLITE LAUNCH VEHICLE.
THIS ROCKET SYSTEM WAS DESIGNED AND DEVELOPED INDIGENOUSLY AT ISRO'S VIKRAM SARABHAI SPACE CENTRE AT TRIVANDRUM. THIS WAS A MAJOR ACHIEVEMENT FOR INDIAN SCIENTISTS. THIS LAUNCH VEHICLE HAD 44 MAJOR PARTS WHICH HAD IN ALL MORE THAN 1,00,000 COMPONENTS.
ROHINI
THERE ARE ONLY A HANDFUL OF COUNTRIES IN THE WORLD WHICH HAVE SATELLITE LAUNCH CAPABILITIES OF THEIR OWN. INDIA JOINED THIS EXCLUSIVE GROUP OF NATIONS WHEN IT LAUNCHED THE ROHINI SATELLITE ON BOARD SLV-3.
SLV-3


BHASKARA
WITH THE EXPERIENCE GAINED IN THE LAUNCHING OF ARYABHATA, INDIAN SPACE SCIENTISTS DECIDED TO FOLLOW IT WITH SPECIAL PURPOSE SATELLITES. THE RESULT WAS THE BHASKARA I SATELLITE.
BHASKARA I AND BHASKARA II WERE LAUNCHED FROM A SOVIET COSMODROME ON JUNE 7, 1979 AND NOVEMBER 20, 1981 RESPECTIVELY. THESE WERE SPECIAL PURPOSE SATELLITES KNOWN AS 'REMOTE SENSING SATELLITES'. REMOTE SENSING MEANS SEEING AND RECORDING THE EARTH'S FEATURES FROM A LONG DISTANCE. THEY COLLECTED VERY USEFUL DATA REQUIRED BY WEATHERMEN (METEOROLOGISTS), AGRICULTURAL EXPERTS AND GEOLOGISTS.

APPLE

THE INDIAN POSTS AND TELEGRAPHS DEPARTMENT AND ISRO WANTED TO LAUNCH A SATELLITE TO CONDUCT EXPERIMENTS IN COMMUNICATIONS, LIKE TRANSMITTING SPEECH AND T.V. PICTURE SIGNALS, RADIO DATA AND CONTACTING REMOTE AREAS. APPLE WAS THE SATELLITE DESIGNED FOR THIS. APPLE, WHICH WEIGHED 672 KG., WAS LAUNCHED BY THE EUROPEAN SPACE AGENCY'S LAUNCH VEHICLE KNOWN AS ARIANE, IN 1981.



INSAT

INSAT-1 IS THE FIRST IN THE SERIES OF MULTI-PURPOSE SATELLITES. INSAT STANDS FOR INDIAN NATIONAL SATELLITE. THESE MULTI-PURPOSE SATELLITES HAVE MANY FUNCTIONS: LONG-DISTANCE TELEPHONE HOOK-UPS, OBSERVATION OF THE EARTH FOR METEOROLOGICAL PURPOSES (TO GIVE OUT TIMELY WARNINGS IN CASE OF APPROACHING NATURAL DISASTERS) AND DIRECT T.V. BROADCASTS. INSAT-I WAS LAUNCHED ON APRIL 10, 1982.

